BIODIVERSITY ASSESSMENT AND MANAGEMENT PLAN FOR ZYDUS WELLNESS LIMITED, ALIGARH

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SUBMITTED TO:
Zydus Wellness, Aligarh

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Table of Contents

1 INTRODUCTION

1.1 Zydus Wellness

Zydus Wellness Products Ltd. is a global leader among consumer wellness companies with health and holistic well-being defining the core of its values. With the launch of India's first zero calorie replacement of sugar, called Sugar Free, in 1988, Zydus Wellness began its journey as is India's leading consumer Wellness Company.Additionally, they manufacture a variety of other innovative, industry leading products like Ghee, Tomato ketchup, Complan, Glucon-D & Everyuth, etc. Headquartered in Ahmedabad, Zydus Wellness enjoys a pan-India marketing presence through a distribution network comprising.

The Company is committed towards environmental responsibility and sustainability. This environmental policy outlines our commitment to minimize our environmental impact and fostering a culture of sustainability within their organization. They also focus on biodiversity protection, energy management, waste disposal, environmental awareness, reducing natural resource consumption and abiding to the environmental laws.

1.2 Business and Biodiversity

Biodiversity, which includes ecosystems, species, and genetic diversity, is critical to the health and stability of the Earth's natural systems. According to the Convention on Biological Diversity, Biodiversity is defined as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". Its significance is multifaceted, providing critical ecological functions such as pollination, nutrient cycling, and climate regulation while also supporting global food security through various crops and livestock breeds. Furthermore, biodiversity has an inherent value, revitalizing both human existence, culture and spirituality.

Businesses activities lead to both direct and indirect impacts on biodiversity and nature's contributions to people, playing a vital role in shaping the health of natural ecosystems. Business operations like manufacturing, production, urban development, mining, agriculture, etc. can result in lost or degraded habitats, overharvesting of species, and pollution, which can directly threaten biodiversity and disturb ecological balance. Indirect influences of business on biodiversity are mediated through socioeconomical and governance frameworks, where policies favouring commercial growth can weaken conservation efforts. Incentivizing or subsidizing unsustainable practices, further aggravates these impacts by land use changes and resource depletion. By adopting sustainable practices and biodiversity considerations in their operations and decision-making processes, businesses can contribute to the preservation of ecosystems and the sustainable provision of nature's contributions to people.

1.3 Scope of Work

- Identification of all floral and faunal species by qualified taxonomist/botanist/zoologist within core and buffer areas (baseline study).
- Segregation of identified species in Schedule-I, II, III and IV classes with special emphasis on cataloguing taxa which are facing risk of extinction (red list), endangered, vulnerable, threatened & rare species
- Impacts on species of high conservation significance (highly threatened species) existing within the habitats of project area with recommendations for conservation measures to be adopted.
- Identification of exotic species and plan for eradication/de weeding.
- Direct impact of loss of forest and non-forest land on habitats and associated biodiversity.
- Impact on water resources and wetland ecosystems.
- Effects of dust and noise pollution on habitat quality of available faunal groups.
- Measures to avoid/reduce the impacts on biodiversity and associated ecosystem services during the life of the business operations.
- Suggested list of native floral species which need to be planted while taking up afforestation activities to offset loss of biodiversity or carbon emissions.
- Measures for long term neutralization of the impacts on biodiversity and nature's contributions to people.

1.4 Legislative and Policy Requirements

1.4.1 The Kunming Montreal Biodiversity Framework

The framework identifies gaps in the Aichi target and is built around a theory of change which recognizes that urgent policy action globally, regionally, and nationally is required to transform economic, social and financial models so that the trends that have exacerbated biodiversity loss will stabilize in the next 10 years (by 2030) and allow for the recovery of natural ecosystems in the following 20 years, with net improvements by 2050 to achieve the Convention's vision of "living in harmony with nature by 2050".

The framework theory assumes that transformative actions are taken to:

- put in place tools and solutions for implementation and mainstreaming
- reduce the threats to biodiversity
- ensure sustainable use of biodiversity to meet people's needs

The draft Framework comprises 21 targets and 10 'milestones' proposed for 2030, en route to 'living in harmony with nature' by 2050. The targets are proposed with the aim to achieve above mentioned objectives. No national targets have been set yet under the post-2020 - Global Biodiversity Framework.

1.4.2 India's Biodiversity Targets

India's Biodiversity underpins ecosystem functions and services that are of great human value. In order to sustain the nature-dependent livelihood of the country, the Government of India has developed National Policy and Macrolevel Action Strategy on Biodiversity in 1999 in accordance with the Convention of Biodiversity (CBD). India has prepared 12 National Biodiversity Targets (NBTs) using the Strategic Plan for Biodiversity (SP) 2011-2020 for Biodiversity as the broad framework (Error! Reference source not found.).

Figure 1. India's National Biodiversity Targets

1.4.3 The Wildlife (Protection) Amendment Act, 2022

The Indian Parliament passed the Wildlife (Protection) Act in 1972 for the safeguard and protection of the wildlife in the country. This act has been revised and amended in the year 2022. The Wild Life (Protection) Amendment Act, 2022, categorizes the wildlife of India into four different schedules, two of which are for animals, third for plants and fourth for the regulation of international trade in endangered species, which are mentioned below in the table. These schedules are rendered varying degrees of

protection, with animals falling under Schedule I and Schedule II being accorded maximum protection. Description of each Schedule is detailed below in the table.

Table 1. Wild Life (Protection) Amendment Act, 2022

Schedule	Description
Schedule I	• Provided absolute protection - offences under these are prescribed the highest penalties
Schedule II	• Protected, penalties lower than that of Schedule I
Schedule III	• Plants which are prohibited from cultivation and planting
Schedule IV	• Regulation of international trade in endangered species of wild fauna and flora

Thus, schedule I is the most essential from a conservation point of view. Whereas animals under schedule II are also accorded high protection, and their trade is prohibited. To implement conservation measures, it is necessary to know whether any of the species listed on these schedules are present in each area, as well as their population status and threats.

1.4.4 The Biological Diversity Act, 2002

This Act provides conservation of biological diversity, and mechanism for equitable sharing of benefits arising out of the use of traditional biological resources and knowledge

The Act prescribes that "any person or corporation or organization of foreign origin needs to procure prior permission from the National Biodiversity Authority (NBA) to obtain any biological resource or knowledge associated with a biological resource found in India, either for research or commercial utilization"

If a person, violates the regulatory provisions he will be punishable with imprisonment for a term extending up to five years, or with fine which may extend up to 10 lakh rupees and where the damage caused exceeds 10 lakh rupees such fine may commensurate with the damage caused, or with both.

- Any offence under this Act is non-bailable and cognizable.

1.4.5 The Taskforce on Nature Based Financial Disclosures (TNFD)

TNFD refers to the Task Force on Nature-related Financial Disclosures. It's an initiative that resembles the Task Force on Climate-related Financial Disclosures (TCFD). The TNFD aims to develop a framework that companies and financial institutions can use to evaluate and reveal their dependencies and impacts on nature. The objective of TNFD is to assist corporations and financial institutions in identifying and managing risks related to biodiversity loss and ecosystem degradation. Additionally, it aims to leverage opportunities associated with nature-positive activities. This framework can assist investors, lenders, and insurers in making

well-informed decisions about their investments and lending practices concerning nature-related risks and opportunities.

The Task Force on Nature-related Financial Disclosures (TNFD) has set forth some primary goals, which include:

1. **Enhanced understanding:** To increase awareness and understanding among financial institutions, corporations, investors, and other stakeholders regarding the significance of nature-related risks and opportunities in financial decision-making.
2. **Improved risk management:** To provide a standardized framework for identifying, assessing, and managing nature-related risks within financial institutions and corporations' operations, supply chains, and investment portfolios.
3. **Disclosure standardization:** To develop consistent and comparable metrics, methodologies, and disclosures for nature-related risks and opportunities, which will be similar to the Task Force on Climate-related Financial Disclosures (TCFD), to facilitate transparency and decision-making.
4. **Integration into Financial Decision-Making:** To promote the integration of nature-related considerations into mainstream financial decision-making processes, including investment, lending, insurance, and corporate strategy.
5. **Encouraging Nature-positive Investments:** To stimulate investment in nature-positive activities and projects that contribute to biodiversity conservation, ecosystem restoration, and sustainable land use practices.
6. **Resilient Financial Systems:** To strengthen the resilience of financial systems and economies by addressing nature-related risks and dependencies, thereby reducing vulnerability to shocks and disruptions associated with biodiversity loss and ecosystem degradation.
7. **Contributing to Global Goals:** To support the achievement of global sustainability goals, such as the United Nations Sustainable Development Goals (SDGs) and the objectives of the Convention on Biological Diversity (CBD), by aligning financial flows with environmentally sustainable outcomes. Overall, the TNFD aims to bring about a shift towards a more sustainable and resilient financial system that recognizes and values nature's contributions to economic prosperity and human well-being.

1.4.6 Business Responsibility and Sustainability Reporting

BRSR stands for Business Responsibility and Sustainability Reporting. This term is often used in the context of corporate reporting requirements related to sustainability and social responsibility. BRSR frameworks typically outline guidelines for companies to disclose their performance and impacts on various environmental, social, and governance (ESG) factors. It entails the systematic disclosure of a company's performance and impacts across

environmental, social, and governance (ESG) dimensions. Below is a brief overview of BRSR:

1. **Scope:** BRSR encompasses an extensive range of factors, including environmental stewardship, social responsibility, ethical governance practices, employee welfare, community engagement, human rights, and more.
2. **Purpose:** The primary objective of BRSR is to provide stakeholders, such as investors, customers, employees, regulators, and communities, with transparent and reliable information about a company's non-financial performance. This enables stakeholders to evaluate a company's sustainability practices, assess its long-term viability, and make informed decisions. Several countries and regulatory bodies have introduced guidelines or mandatory reporting requirements for BRSR to institutionalize sustainability reporting and ensure consistency and comparability of disclosures across companies.
3. **Standards and frameworks:** Various international standards and frameworks exist to guide BRSR, such as the Global Reporting Initiative (GRI), the Sustainability Accounting Standards Board (SASB), the Task Force on Climate-related Financial Disclosures (TCFD), and others. These frameworks provide principles, indicators, and guidelines for companies to structure their sustainability disclosures. Integration with Financial Reporting: BRSR is increasingly being integrated with financial reporting to provide a comprehensive view of a company's overall performance and value creation. Integrated reporting frameworks, such as the International Integrated Reporting Council (IIRC) framework, aim to merge financial and non-financial information into a single, cohesive report.
4. **Stakeholder engagement:** Effective BRSR involves engaging with stakeholders to identify material issues, set targets, and establish meaningful performance indicators. Companies often conduct stakeholder consultations and engage in dialogue to understand stakeholder expectations and concerns.
5. **Benefits:** Adopting robust BRSR practices offers several benefits, including improved risk management, enhanced reputation and brand value, access to capital, increased stakeholder trust and loyalty, and a competitive advantage in attracting talent and customers.

1.4.7 Dow Jones Sustainability Index

The Dow Jones Sustainability Indices (DJSI) are a family of indices containing one main DJSI World global index, along with various geographic region-based indexes such as: Europe, Nordic, North America and Asia Pacific, operated through a strategic partnership between S&P Dow Jones Indices and RobecoSAM (Sustainable Asset Management). DJSI evaluates the performance of numerous public companies based on their sustainable practices.

1. **Scope:** It has well defined general as well as specific sustainability criteria for each of the 60 industry types defined as per the Industry Classification Benchmark (ICB).
2. **Stakeholder engagement:** To be listed in the DJSI, the long-term economic, environmental, and social performance of a company is assessed based on its sustainable practices in issues such as corporate governance, risk management, branding, climate

change mitigation, supply chain standards and labour management. The companies not operating in a sustainable manner are usually rejected from the Index.

3. **Benefits:** Established in 2012 by the merger of S&P Indices and Dow Jones Indexes, they are the pioneer sustainability benchmarks having a global relevance and have become a standard reference in sustainability investing for capitalists and companies.

DJSI holds industries to keep a check on the biodiversity at its operational unit with consideration of the risks associated with the operations and proposes to take action accordingly.

2 STUDY AREA

Geographically, Aligarh district is part of Yamuna-Ganga doab. The upper Ganga canal flowing from NW to SE direction divides the district in two unequal parts, the western (a part of Yamuna sub basin) and the Eastern (a part of Ganga sub basin). The study area falls towards east of the canal, represented by a relatively flat topography at an elevation of around 220 m above MSL. As per the 10 biogeographical zones of India, the study area falls under the Gangetic Plain. The characteristic forest type associated with this zone ranges from tropical thorn forest to tropical dry deciduous forests (Champion and Seth, 1968).

For the proposed study, the manufacturing unit and colony (core area) and surrounding 2 km radius buffer area was considered. The core area primarily composed of infrastructure, and plantation, while the surrounding buffer area was majorly covered by scrubland and croplands.

Protected wetlands / Ramsar sites / or other protected forests are absent within 2 km. from the study area.

Figure 2: Map of the study area

3 APPROACH AND METHODOLOGY

3.1 Bioidversity Assessment

Biodiversity assessment is the collection of baseline data on the ecosystem and biodiversity present at a given location and their interactions with each other. This includes both off-site and on-site studies where data was collected.

For onfield assessment, Stratified Random Sampling method was used wherein the study area was divided into different strata based on their land use pattern, and randomly sampling points were selected for the study.

Following methodology was used for flora and fauna assessment:

	Habit/ Taxa	Method
Flora Survey	Trees	• 10 m circular plot (List Count Method)
	Shrubs and Climbers	• 5 m concentric circle (List Count Method)
	Herbs	• 1 m x 1 m quadrat
Fauna Survey	Avifauna	• Point Center Count • Aquatic: Total Count
	Herpetofauna	• Visual Encounter • Opportunistic sighting
	Mammals	• Direct Sighting (Visual Encounter) • Indirect sightings (droppings, scat, other tracts and signs)
	Other insects and Arachnids	• Opportunistic sighting

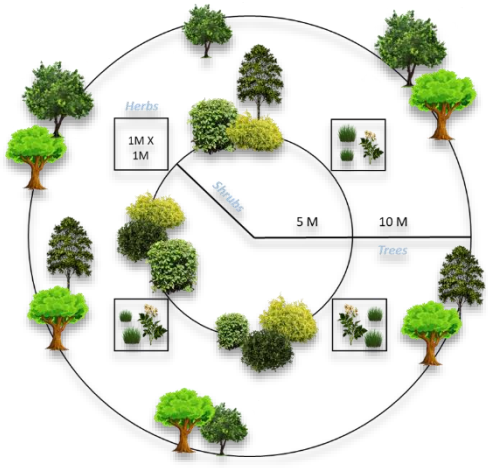

Figure 3. Flora assessment methodology

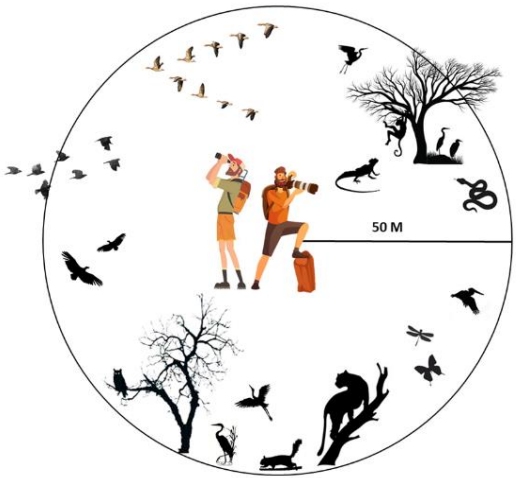

Figure 3: Fauna assessment methodology

The species were analysed for different attributes such as Simpson's diversity index and Shannon and Weiner diversity index; conservation status of the species as per IUCN and WPA, 2022. Also, the bird species were assessed for their residential and migratory status.

For latest scientific names of flora, website (https://www.ipni.org/) was referred. Global Invasive Species Database (GISD) and data from Invasive Species Compendium – Commonwealth Agricultural Bureaux International (ISC-CABI) were referred to assess indigenous status and invasiveness of floral species.

Tools such as Google Earth Pro, Arch GIS, GPS Essentials, and NatureNotes (Application developed by Terracon for data collection) were used for the study.

3.2 Dependency and Impact Assesment

An Ecosystem Services Review tool was used to idendity priority ecosystem services. Ecosystem Services Review is a tool developed by the World Resources Institute (WRI), World Business Council for Sustainable Development (WBCSD), and Meridian Institute. It helps industries to identify their dependencies and impacts on biodiversity and ecosystem services. The output of the exercise is a better understanding of risks and dependencies as well as strategic action plans for consideration of ecosystem services in the future activities of the industries. It is a tool for corporate strategy development and can augment existing environmental management systems. A predefined tool was used to carry out the exercise, which included rigorous discussions with the client.

Figure 3. Ecosystem Service Review Methodology

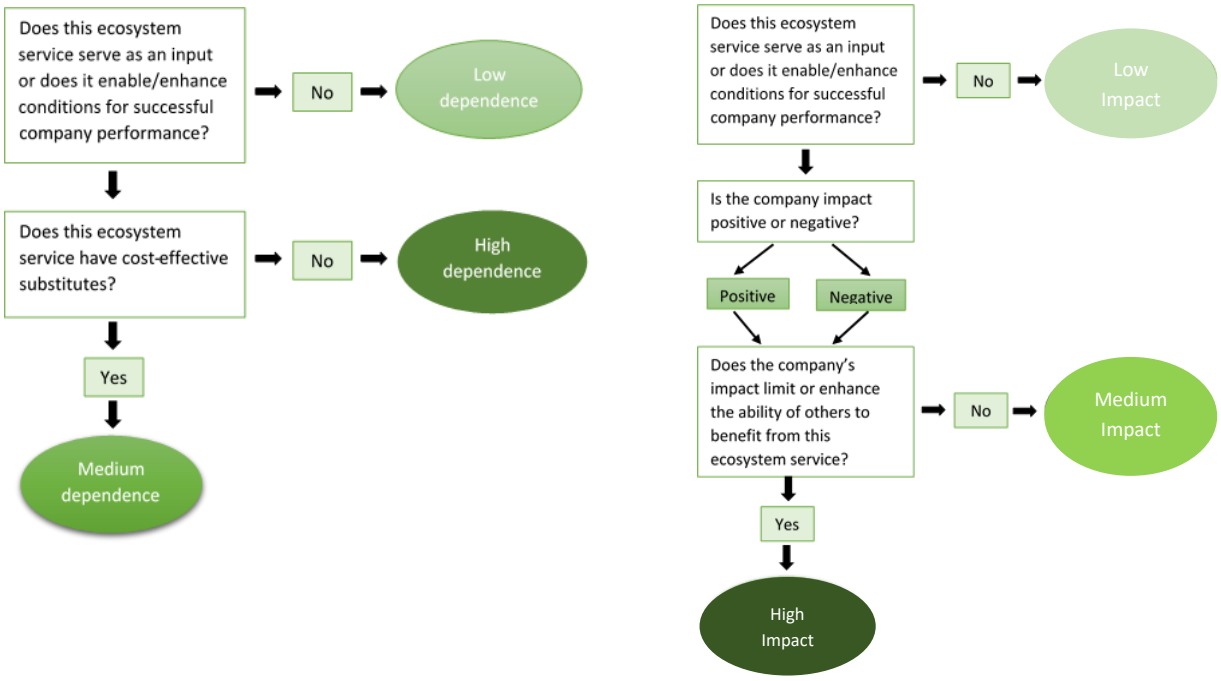

Figure 4: Method to Identify Priority Ecosystem Services

4 BIODIVERSITY OBSERVATION AND ANALYSIS

4.1 Habitats

The core area is significantly altered, with Built-Up serving as the most frequently observed habitat, followed by plantation in the resident's colony. The habitats prevailing in the 2 km buffer area were adjoining scrubland and croplanmds towards the periphery of the buffer.

4.2 Flora Observations

The residential colony inside the core comprised majorly of ornamental exotic species belonging to Asparagaceae and Asteraceae along with some of the invasive species like Carrot grass (*Parthenium hysterophorus*) and Flax-leaf Fleabane (*Erigeron bonariensis*).

The residents had developed kitchen gardens, growing edible plant species and a Guava (*Psidium guajava*) orchard which showed the presence of 2 individuals of Wild Tamarind (*Leucaena leucocephala*). It also housed some old native tree species such as Arjun (*Terminalia arjuna*), Indian Siris (*Albizia lebbek*), Flame of the Forest (*Butea monosperma*), Indian Rosewood (*Dalbergia sissoo*), Margosa tree (*Azadirachta indica*), Wood apple (*Aegle marmelos*), and Drumstick tree (*Moringa oleifera*). The presence of palms, both native and exotic was also noted.

The 10-acre husk storage area was dominated by Blue gum tree (*Eucalyptus globulus*) and Siamese Cassia (*Cassia siamea*) which were interspersed by a few juvenile Pongam trees (*Pongamia pinnata*), left as remains of a failed attempt at Miyawaki Plantation. While the area towards the periphery was dominated by Algaroba (*Prosopis juliflora*) along with Indian Mallow (*Abutilon indicum*), Devil's trumpet (*Datura metel*), Carrot grass (*Parthenium hysterophorus*), and Bristly *verticillata*), similar to the surrounding scrublands.

The buffer area comprised majorly of scrubland and agricultural croplands. The crop under cultivation during the study were Mustard (*Brassica juncea*), and Wheat (*Triticum aestivum*). Majority of the croplands, especially the Wheat cultivated ones, showed aggressive growth of Hemp (Cannabis sativa) towards the periphery.

The scrubland was characterized by the presence of sparsely distributed Algaroba (*Prosopis juliflora*) which was interspersed by various shrubs like Indian Mallow (*Abutilon indicum*), and Black-Honey shrub (*Phyllanthus reticulatus*), herbs including Comb Rungia (*Rungia pectinata*), Joseph's coat (*Alternanthera ficoidea*), Prickly Chaff Flower (*Achyranthes aspera*), Tridax Daisy (*Tridan procumbens*), Common Cocklebur (*Xanthium strumarium*), Indian Catmint (*Anisomeles indica*), Heart-leaf Sida (*Sida cordata*), Damascisa (*Glinus lotoides*), and Small Knotweed (*Polygonum plebeium*), and grasses including Japanese Lovegrass (*Eragrostis tenella*), Crowfoot Grass (*Dactyloctenium aegyptium*), Bristly Foxtail (*Setaria verticillata*), and

Golden Beardgrass (*Chrysopogon zizanoides*). Towards the roadside, these scrublands showed the presence of certain climbers like Snake Gourd (*Trichosanthes cucumerina*), Broom Creeper (*Cocculus hirsutus*), and Pergularia (*Pergularia daemia*), along with Torpedo Grass (*Panicum repens*), and Kans Grass (Saccharum spontaneum).

The wetlands examined showed the presence of typical associated species such as Knotgrass (*Paspalum distichum*), Water Hyacinth (*Eichhornia crassipes*), Water Pepper (*Persicariahydropiper*), and Duckweed (*Lemna minor*).

Some open vegetation cover was also encountered which had typical tree species like Blue Gum tree (*Eucalyptus globulus*), Margosa tree (*Azadirachta indica*), shrubs like Rubber Bush (*Calotropis procera*), and herbs like Ban Tulsi (*Croton bonplandianus*), Perennial Water Primrose (*Ludwigia perennis*), and Wild Basil (*Ocimum americanum*).

Table 2: Summary of Findings (Flora)

Sr. no.	Habit	Number of Species		
		Core	Buffer	Study Area
1	Trees	55	35	70
2	Shrubs	18	06	20
3	Herbs	78	39	104
4	Climbers	06	12	14

4.2.1 Trees

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	ORIGIN	IUCN STATUS	GISD STATUS (INDIA)	CORE	BUFFER
1	*Aegle marmelos*	Wood apple	Rutaceae	Native	NT	–	+	+
2	*Ailanthus excelsa*	Indian tree of heaven	Simaroubaceae	Native	-	–	-	+
3	*Albizia lebbeck*	Indian siris	Fabaceae	Native	LC	–	+	-
4	*Albizia procera*	White siris	Fabaceae	Native	LC	–	+	-
5	*Alstonia scholaris*	Scholars tree	Apocynaceae	Native	LC	–	+	+
6	*Annona squamosa*	Custard apple	Annonaceae	Exotic	LC	–	+	-
7	*Araucaria columnaris*	Christmas tree	Araucariaceae	Exotic	LC	–	+	-
8	*Azadirachta indica*	Margosa tree	Meliaceae	Native	LC	–	+	+
9	*Bauhinia purpurea*	Purple Orchid tree	Fabaceae	Native	LC	–	-	+
10	*Butea monosperma*	Flame of the forest	Fabaceae	Native	LC	–	+	-
11	*Callistemon lanceolatus*	Bottle brush	Myrtaceae	Exotic	-	–	-	+
12	*Carica papaya*	Papaya	Caricaceae	Exotic	-	–	+	-
13	*Caryota urens*	Fishtail palm	Arecaceae	Native	LC	–	+	-
14	*Cascabela thevetia*	Mexican Oleander	Apocynaceae	Exotic	LC	–	+	-
15	*Cassia fistula*	Golden shower tree	Fabaceae	Native	LC	–	+	-
16	*Citrus limon*	Lemon	Rutaceae	Native	-	–	+	-
17	*Cordia dichotoma*	Indian cherry	Boraginaceae	Native	LC	–	-	+
18	*Cycas revoluta*	Sago palm	Cycadaceae	Exotic	LC	–	+	-
19	*Dalbergia sissoo*	Indian rosewood	Fabaceae	Native	LC	–	+	+
20	*Delonix regia*	Flame tree	Fabaceae	Exotic	LC	–	+	-
21	*Dypsis lutescens*	Golden cane palm	Arecaceae	Exotic	NT	–	+	-
22	*Eucalyptus globulus*	Blue gum tree	Myrtaceae	Exotic	LC	–	+	+
23	*Fernandoa adenophylla*	Katsagon	Bignoniaceae	Native	-	–	-	+
24	*Ficus auriculata*	Giant Indian fig	Moraceae	Native	LC	–	+	-
25	*Ficus benghalensis*	Banyan tree	Moraceae	Native	-	–	+	-
26	*Ficus benjamina*	Weeping fig	Moraceae	Native	LC	–	+	+

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	ORIGIN	IUCN STATUS	GISD STATUS (INDIA)	CORE	BUFFER
27	*Ficus elastica*	Indian rubber tree	Moraceae	Native	-	–	+	-
28	*Ficus lyrata*	Fiddle-leaf fig	Moraceae	Exotic	-	–	+	-
29	*Ficus maclellandii*	Ficus alli	Moraceae	Exotic	-	–	+	-
30	*Ficus microcarpa*	Chinese banyan	Moraceae	Native	LC	–	+	-
31	*Ficus natalensis subsp. leprieurii*	Triangle fig	Moraceae	Exotic	LC	–	+	-
32	*Ficus palmata*	Punjab fig	Moraceae	Native	-	–	-	+
33	*Ficus racemosa*	Cluster fig	Moraceae	Native	LC	–	-	+
34	*Ficus religiosa*	sacred fig tree	Moraceae	Native	-	–	+	+
35	*Ficus virens*	White fig	Moraceae	Native	LC	–	+	+
36	*Grevillea robusta*	Silver oak	Proteaceae	Exotic	LC	–	+	-
37	*Holoptelea integrifolia*	Indian elm	Ulmaceae	Native	-	–	+	+
38	*Juniperus chinensis*	Chinese Juniper	Cupressaceae	Exotic	LC	–	+	-
39	*Lagerstroemia speciosa*	Queen crape myrtle	Lythraceae	Native	-	–	-	+
40	*Leucaena leucocephala*	Wild tamarind, River tamarind	Fabaceae	Exotic	-	Invasive	+	+
41	*Livistona chinensis*	Chinese fan palm	Arecaceae	Exotic	-	–	+	-
42	*Mangifera indica*	Mango	Anacardiaceae	Native	DD	–	+	+
43	*Melaleuca bracteata*	Golden bottle brush	Myrtaceae	Exotic	DD	–	+	-
44	*Melia azedarach*	Chinaberry tree	Meliaceae	Native	LC	–	-	+
45	*Mimusops elengi*	Spanish cherry	Sapotaceae	Native	LC	–	+	-
46	*Mitragyna parvifolia*	Kaim	Rubiaceae	Native	-	–	-	+
47	*Moringa oleifera*	Drumstick tree	Moringaceae	Native	LC	–	+	+
48	*Morus alba*	White mulberry	Moraceae	Native	-	–	+	+
49	*Murraya koenigii*	Curry leaf	Rutaceae	Native	LC	–	+	-
50	*Nyctanthes arbor-tristis*	Queen of the night	Oleaceae	Native	-	–	+	-
51	*Persea americana*	Avocado	Lauraceae	Exotic	LC	–	+	-
52	*Phoenix sylvestris*	Khajur	Arecaceae	Native	-	–	-	+
53	*Phyllanthus emblica*	Indian gooseberry	Euphorbiaceae	Native	LC	–	+	-

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	ORIGIN	IUCN STATUS	GISD STATUS (INDIA)	CORE	BUFFER
54	*Platycladus orientalis*	Oriental thuja	Cupressaceae	Exotic	NT	–	+	-
55	*Plumeria rubra*	Red frangipani	Apocynaceae	Exotic	LC	–	+	-
56	*Polyalthia longifolia*	Mast tree	Annonaceae	Native	-	–	+	-
57	*Pongamia pinnata*	Pongam tree	Fabaceae	Native	LC	–	+	+
58	*Prosopis juliflora*	Algaroba	Fabaceae	Exotic	-	Invasive	+	+
59	*Psidium guajava*	Guava	Myrtaceae	Exotic	LC	Invasive	+	+
60	*Punica granatum*	Pomogranate	Lythraceae	Native	LC	–	+	-
61	*Ricinus communis*	Castor	Euphorbiaceae	Exotic	-	Invasive	-	+
62	*Roystonea regia*	Royal bottle palm	Arecaceae	Exotic	LC	–	+	-
63	*Senna siamea*	Siamese cassia	Fabaceae	Native	LC	–	+	+
64	*Spathodea campanulata*	African tulip Tree	Bignoniaceae	Exotic	LC	Invasive	-	+
65	*Syzygium cumini*	Jamun	Myrtaceae	Native	LC	–	+	+
66	*Tabernaemontana divaricata*	Crape Jasmine	Apocynaceae	Native	LC	–	+	-
67	*Tectona grandis*	Teak	Lamiaceae	Native	EN	–	-	+
68	*Terminalia arjuna*	Arjun	Combretaceae	Native	-	–	+	+
69	*Vachellia nilotica*	Babool	Fabaceae	Native	LC	–	+	+
70	*Ziziphus mauritiana*	Indian jujube	Rhamnaceae	Native	LC	–	-	+

Note:
LC: Least Concern; EN: Endangered; DD: Data Deficient; NT: Near Threatened

4.2.2 Shrubs

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	ORIGIN	IUCN STATUS	GISD STATUS (INDIA)	CORE	BUFFER
1	*Abutilon indicum*	Indian Mallow	Malvaceae	Native	-	–	+	+
2	*Acalypha wilkesiana*	Copperleaf	Euphorbiaceae	Exotic	-	–	+	-

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	ORIGIN	IUCN STATUS	GISD STATUS (INDIA)	CORE	BUFFER
3	*Acalypha wilkesiana*	Copperleaf	Euphorbiaceae	Exotic	-	–	+	-
4	*Adenium obesum*	Desert Rose	Apocynaceae	Exotic	LC	–	+	-
5	*Alternanthera brasiliana* var. *brasiliana*	Joseph's coat	Amaranthaceae	Exotic	-	–	+	-
6	*Calotropis procera*	Rubber bush	Apocynaceae	Native	-	–	+	+
7	*Codiaeum variegatum*	Garden croton	Euphorbiaceae	Exotic	-	–	+	-
8	*Dracena fragrans*	Corn plant	Asparagaceae	Exotic	-	–	+	-
9	*Duranta erecta*	Sky flower	Verbenaceae	Exotic	LC	–	+	-
10	*Euphorbia tirucalli*	Pencil Tree	Euphorbiaceae	Native	LC	–	+	-
11	*Hamelia patens*	Firebush	Rubiaceae	Exotic	LC	–	+	-
12	*Hibiscus rosa-sinensis*	Shoe flower	Malvaceae	Exotic	-	–	+	-
13	*Jatropha integerrima*	Peregrina	Euphorbiaceae	Exotic	-	–	+	-
14	*Lantana camara*	Lantana	Rubiaceae	Exotic	-	Invasive	-	+
15	*Lawsonia inermis*	Henna	Lythraceae	Native	LC	–	+	-
16	*Nerium oleander*	Oleander	Apocynaceae	Native	LC	–	+	+
17	*Phyllanthus reticulatus*	Black-Honey Shrub	Phyllanthaceae	Native	LC	–	+	+
18	*Plumbago zeylanica*	Chitrak	Plumbaginaceae	Native	-	–	-	+
19	*Pseuderanthemum maculatum*	Black Varnish plant	Acanthaceae	Exotic	-	–	+	-
20	*Rosa chinensis*	Green Rose	Rosaceae	Exotic	-	–	+	-

Note:
LC: Least Concern

4.2.3 Herbs

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	ORIGIN	IUCN STATUS	GISD STATUS (INDIA)	CORE	BUFFER
1	*Acalypha indica*	Indian Copperleaf	Euphorbiaceae	Native	-	NA	+	-
2	*Achyranthes aspera*	Prickly Chaff Flower	Amaranthaceae	Native	-	NA	+	+

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	ORIGIN	IUCN STATUS	GISD STATUS (INDIA)	CORE	BUFFER
3	*Agave americana*	Agave	Asparagaceae	Exotic	LC	NA	+	-
4	*Alcea setosa*	Bristly Hollyhock	Malvaceae	Exotic	-	NA	+	-
5	*Aloe vera*	aloe vera	Asphodelaceae	Exotic	-	NA	+	-
6	*Alternanthera ficoidea*	Joseph's coat	Amaranthaceae	Exotic	-	Invasive	-	+
7	*Alternanthera sessilis*	Sessile Joyweed	Amaranthaceae	Native	-	Invasive	-	+
8	*Amaranthus viridis*	Slender Amaranth	Amaranthaceae	Exotic	-	NA	+	-
9	*Anisomeles indica*	Indian catmint	Lamiaceae	Native	-	NA	-	+
10	*Asparagus densiflorus*	Asparagus fern	Asparagaceae	Exotic	-	Invasive	+	-
11	*Asparagus setaceus*	Ferny asparagus	Asparagaceae	Exotic	-	NA	+	-
12	*Aster* sp.	-	Asteraceae	-	-	NA	+	-
13	*Bambusa bambos*	Indian Thorny Bamboo	Poaceae	Native	-	NA	+	-
14	*Bambusa tuldoides*	Buddha Belly Bamboo	Poaceae	Exotic	-	NA	+	-
15	*Bassia scoparia*	Burningbush	Amaranthaceae	Native	-	NA	+	-
16	*Brassica juncea*	Mustard	Brassicaceae	Exotic	-	NA	+	+
17	*Brassica oleracea*	Cauliflower	Brassicaceae	Exotic	DD	NA	+	-
18	*Brassica rapa*	Turnip Rape	Brassicaceae	Exotic	DD	NA	+	-
19	*Bryophyllum pinnatum*	Air Plant	Crassulaceae	Exotic	-	NA	+	-
20	*Calendula officinalis*	English Marigold	Asteraceae	Exotic	-	NA	+	-
21	*Calendula stellata*	Sicilian Marigold	Asteraceae	Exotic	-	NA	+	-
22	*Cannabis sativa*	Hemp	Cannabaceae	Native	-	Invasive	-	+
23	*Cardamine flexuosa*	Wavy Bittercress	Brassicaceae	Exotic	-	Invasive	+	-
24	*Catharanthus roseus*	Periwinkle	Apocynaceae	Exotic	-	NA	+	-
25	*Chloris barbata*	Swollen Finger Grass	Poaceae	Native	-	NA	+	-
26	*Chlorophytum comosum*	Spider Plant	Asparagaceae	Exotic	-	NA	+	-
27	*Chrysanthemum indicum*	Indian Chrysanthemum	Asteraceae	Exotic	-	NA	+	-
28	*Chrysopogon zizanioides*	Golden Beardgrass	Poaceae	Native	-	NA	-	+
29	*Cordyline australis*	Cabbage tree	Asparagaceae	Exotic	-	NA	+	-

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	ORIGIN	IUCN STATUS	GISD STATUS (INDIA)	CORE	BUFFER
30	*Coriandrum sativum*	Coriander	Apiaceae	Exotic	-	NA	+	-
31	*Crinum asiaticum* var. *pedunculatum*	Grand crinum lily	Amaryllidaceae	Exotic	-	NA	+	+
32	*Croton bonplandianus*	Ban tulsi	Euphorbiaceae	Exotic	-	NA	-	+
33	*Cyanthillium cinereum*	Little ironweed	Asteraceae	Native	-	NA	+	+
34	*Cymbopogon citratus*	Lemon Grass	Poaceae	Native	-	NA	+	-
35	*Cynodon dactylon*	Bermuda Grass	Poaceae	Native	-	NA	+	+
36	*Cyperus alternifolius*	Umbrella palm	Cyperaceae	Exotic	LC	NA	+	-
37	*Dactyloctenium aegyptium*	Crowfoot Grass	Poaceae	Native	-	NA	+	+
38	*Dahlia pinnata*	Single Flowered Dahlia	Asteraceae	Exotic	-	NA	+	-
39	*Datura metel*	Devil's trumpet	Solanaceae	Exotic	-	NA	+	-
40	*Daucus carota*	Carrot	Apiaceae	Native	LC	NA	+	-
41	*Desmodium* sp.	-	Fabaceae	-	-	NA	+	-
42	*Dicanthium annulatum*	Marvel Grass	Poaceae	Native	-	NA	-	+
43	*Dicliptera paniculata*	Panicled Foldwing	Acanthaceae	Native	-	NA	-	+
44	*Dracaena hyacinthoides*	Snake plant	Asparagaceae	Exotic	-	NA	+	-
45	*Dracaena trifasciata*	Mother-in-law's tongue / Snake Plant	Asparagaceae	Exotic	-	NA	+	-
46	*Eclipta prostrata*	Eclipta	Asteraceae	Exotic	-	NA	-	+
47	*Eichhornia crassipes*	Water Hyacinth	Pontederiaceae	Exotic	-	Invasive	-	+
48	*Eleusine indica*	Indian goosegrass	Poaceae	Native	LC	NA	+	-
49	*Eragrostis tenella*	Japanese Lovegrass	Poaceae	Native	-	NA	+	-
50	*Erigeron bonariensis*	Flax-leaf Fleabane	Asteraceae	Exotic	-	Invasive	+	-
51	*Euphorbia granulata*	Prostrate Spurge	Euphorbiaceae	Native	-	NA	+	-
52	*Euphorbia hirta*	Asthma Weed	Euphorbiaceae	Exotic	-	NA	+	-
53	*Euphorbia tithymaloides*	Japanese Poinsettia	Euphorbiaceae	Exotic	LC	NA	+	-
54	*Evolvulus nummularius*	Roundleaf Bindweed	Convolvulaceae	Exotic	-	Invasive	+	+
55	*Furcraea foetida*	Mauritius Hemp	Asparagaceae	Exotic	-	Invasive	+	-
56	*Gamochaeta pensylvanica*	Pennsylvania Cudweed	Asteraceae	Exotic	-	NA	+	-

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	ORIGIN	IUCN STATUS	GISD STATUS (INDIA)	CORE	BUFFER
57	*Glinus lotoides*	Damascisa	Molluginaceae	Native	LC	NA	-	+
58	*Lemna minor*	Duckweed	Araceae	Native	LC	NA	-	+
59	*Lepidium sativum*	Garden Cress	Brassicaceae	Exotic	-	NA	+	-
60	*Ludwigia perennis*	Perennial Water Primrose	Onagraceae	Native	LC	NA	-	+
61	*Malvastrum coromandelianum*	False Mallow	Malvaceae	Exotic	-	NA	+	+
62	*Mazus pumilus*	Asian mazus	Phrymaceae	Native	-	NA	+	-
63	*Melilotus indicus*	Sweet clover	Fabaceae	Native	-	NA	+	-
64	*Musa paradisiaca*	Banana	Musaceae	Exotic	-	NA	+	+
65	*Ocimum americanum*	Wild basil	Lamiaceae	Native	-	NA	-	+
66	*Ocimum tenuiflorum*	Holy basil	Lamiaceae	Native	-	NA	+	-
67	*Oldenlandia corymbosa*	Flat-top Mille Graines	Rubiaceae	Native	-	NA	+	-
68	*Oxalis corniculata*	Creeping Oxalis	Oxalidaceae	Exotic	-	NA	+	+
69	*Panicum repens*	Torpedo Grass	Poaceae	Native	LC	Invasive	-	+
70	*Parthenium hysterophorus*	Carrot Grass	Asteraceae	Exotic	-	Invasive	+	+
71	*Paspalum distichum*	Knotgrass	Poaceae	Exotic	LC	NA	-	+
72	*Persicaria hydropiper*	Water Pepper	Polygonaceae	Native	LC	NA	-	+
73	*Phyllanthus amarus*	Gulf Leaf-Flower	Phyllanthaceae	Exotic	-	NA	+	-
74	*Polygonum plebeium*	Small Knotweed	Polygonaceae	Native	LC	NA	-	+
75	*Portulaca grandiflora*	Moss-rose purslane	Portulacaceae	Exotic	-	NA	+	-
76	*Portulacaria afra*	Dwarf jade	Didiereaceae	Exotic	LC	NA	+	-
77	*Rungia pectinata*	Comb Rungia	Acanthaceae	Native	-	NA	-	+
78	*Ruscus hypophyllum*	Horse Tongue Lily	Asparagaceae	Exotic	-	NA	+	-
79	*Saccharum spontaneum*	Kans Grass	Poaceae	Native	LC	NA	-	+
80	*Selenicereus triangularis*	Queen of the Night	Cactaceae	Exotic	-	NA	+	-
81	*Senna occidentalis*	Coffee Senna	Fabaceae	Exotic	-	NA	-	+
82	*Setaria verticillata*	Bristly Foxtail	Poaceae	Native	-	NA	+	+
83	*Sida acuta*	Common Wireweed	Malvaceae	Native	-	NA	-	+

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	ORIGIN	IUCN STATUS	GISD STATUS (INDIA)	CORE	BUFFER
84	*Sida cordata*	Heart-leaf Sida	Malvaceae	Native	-	NA	-	+
85	*Solanum lycopersicum*	Tomato	Solanaceae	Exotic	-	NA	+	-
86	*Solanum melongena*	Brinjal / Eggplant	Solanaceae	Exotic	-	NA	+	-
87	*Solanum nigrum*	Black Nightshade	Solanaceae	Native	-	NA	+	+
88	*Sonchus asper*	Prickly Sow-Thistle	Asteraceae	Native	-	NA	+	-
89	*Sonchus oleraceus*	Hare's-lettuce	Asteraceae	Exotic	-	NA	+	-
90	*Spergula arvensis*	Corn Spurry	Caryophyllaceae	Native	-	NA	+	-
91	*Syngonium podophyllum*	Arrowhead plant	Araceae	Exotic	-	Invasive	+	-
92	*Tagetes erecta*	Marigold	Asteraceae	Exotic	-	NA	+	-
93	*Tagetes patula*	French Marigold	Asteraceae	Exotic	-	NA	+	-
94	*Tephrosia purpurea*	Purple Tephrosia	Fabaceae	Native	-	NA	-	+
95	*Tradescantia pallida*	Purple heart	Commelinaceae	Exotic	-	NA	+	-
96	*Tradescantia spathacea*	Oyster plant	Commelinaceae	Exotic	-	Invasive	+	-
97	*Tridax procumbens*	Tridax Daisy	Asteraceae	Exotic	-	NA	+	-
98	*Trigonella foenum-graecum*	Fenugreek	Fabaceae	Exotic	-	NA	+	-
99	*Triticum aestivum*	Wheat	Poaceae	Native	-	NA	-	+
100	*Tropaeolum majus*	Nasturtium	Tropaeolaceae	Exotic	-	NA	+	-
101	*Veronica anagallis-aquatica*	Blue Water-speedwell	Plantaginaceae	Native	LC	NA	+	-
102	*Xanthium strumarium*	Common Cocklebur	Asteraceae	Native	-	NA	-	+
103	*Yucca aloifolia*	Spanish Dagger	Asparagaceae	Exotic	DD	NA	+	-
104	*Zephyranthes candida*	White Rain Lily	Amaryllidaceae	Exotic	-	NA	+	-

Note:
LC: Least Concern; DD: Data Deficient

4.2.4 Climbers

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	ORIGIN	IUCN STATUS	GISD STATUS (INDIA)	CORE	BUFFER
1	*Bougainvillea glabra*	Bougainvillea	Nyctaginaceae	Exotic	LC	NA	+	-
2	*Coccinia grandis*	Ivy gourd	Cucurbitaceae	Native	-	Invasive	+	+
3	*Cocculus hirsutus*	Broom Creeper	Menispermaceae	Native	-	NA	+	+
4	*Combretum indicum*	Burma creeper	Combretaceae	Native	-	NA	+	-
5	*Epipremnum aureum*	Money Plant / Golden pothos	Araceae	Exotic	-	NA	+	+
6	*Lablab purpureus*	Hyacinth bean	Fabaceae	Native	-	NA	-	+
7	*Luffa cylindrica*	Sponge gourd	Cucurbitaceae	Native	-	NA	-	+
8	*Merremia hederacea*	Ivy Woodrose	Convolvulaceae	Native	-	NA	-	+
9	*Momordica charantia*	Bitter-melon	Cucurbitaceae	Native	-	NA	-	+
10	*Oxystelma esculentum*	Rosy Milkweed Vine	Apocynaceae	Native	LC	NA	-	+
11	*Pergularia daemia*	Pergularia	Asclepiadaceae	Native	LC	NA	-	+
12	*Teramnus labialis*	Mashparui	Fabaceae	Native	-	NA	+	+
13	*Tetrastigma* sp.	-	Vitaceae	Native	-	NA	-	+
14	*Trichosanthes cucumerina*	Snake Gourd	Cucurbitaceae	Native	-	NA	-	+

Note:
LC: Least Concern

4.3 Fauna Observations

The residential core area harbors a diverse avifaunal community of migratory and resident species, with approximately 41 species recorded. This diversity includes primarily insectivores and granivores, observed roosting and perching within the residential area, the adjacent 10-acre husk storage area, and other protected lands and plantations within the company area.

Prominent bird species included the Asian Pied Starling (*Gracupica contra*), Bank Myna (*Acridotheres ginginianus*), and Common Myna (*Acridotheres tristis*), seen at dawn in murmurations. Other notable species included the Rose-ringed Parakeet (*Psittacula krameri*), Jungle Babbler (*Turdoides striata*), Little Egret (*Egretta garzetta*), Purple Sunbird (*Cinnyris asiaticus*), Collared Dove (*Streptopelia decaocto*), Rufous Treepie (*Dendrocitta vagabunda*), and Red-wattled Lapwing (*Vanellus indicus*), which have acclimated well to the urban setting within the plant. No conflicts with Rock Doves (*Columba livia*) were reported within plant operations. Near the husk storage area, the Brown Rock Chat (*Oenanthe fusca*), Indian Robin (*Copsychus fulicatus*), and White Wagtail (*Motacilla alba*) were observed feeding and perching. Additionally, a flock of Indian Thick-knees (*Burhinus indicus*) was sighted near the guava orchard, utilizing the area's camouflage-friendly environment. Adjacent to the husk storage area, a small pond supported winter migratory birds such as the Red-breasted Flycatcher (*Ficedula parva*), White Wagtail, and waterbirds like the White-breasted Waterhen (*Amaurornis phoenicurus*), Black-winged Stilts (*Himantopus himantopus*), and red wattled lapwing, the very area, previously utilized for a Miyawaki forest, holds potential for restoration into an effective habitat for birds if conserved. In contrast, the effluent treatment plant (ETP) was noted to be less diverse, with low activity observed, including a few egrets and Rock Doves.

The buffer area surrounding the core zone comprises croplands, wetlands, and two scrubland patches, supporting diverse avifauna and overlapping with the habitats observed in the residential zone. Waders such as the Red-wattled Lapwing, Moorhen (*Gallinula chloropus*), Little Grebe (*Tachybaptus ruficollis*), Spot-billed Duck (*Anas poecilorhyncha*), Black-winged Stilts, Red-naped Ibis (*Pseudibis papillosa*), and Black Drongo (*Dicrurus macrocercus*) were recorded, indicating habitat connectivity. Similar species compositions were observed between the core and immediate buffer zones. Notable avian species in the broader study area included the Egyptian Vulture (*Neophron percnopterus*), classified as Endangered by the IUCN, and the Woolly-necked Stork (*Ciconia episcopus*), categorized as Vulnerable. These species highlight the critical role of local habitats in supporting both resident and migratory birds.

Mammals and Reptiles

Resident mammals within the core area included the Common Palm Squirrel (*Funambulus palmarum*), Grey Mongoose (*Herpestes edwardsii*), and Pipistrelle Bats (*Pipistrellus* spp.). A

family of Rhesus Macaques (*Macaca mulatta*) exhibited regular movement within the core zone and nearby residential areas, with no recorded human-wildlife conflicts, suggesting stable coexistence.

The buffer zone also supports additional mammals. Reports indicated the presence of Nilgai (*Boselaphus tragocamelus*), locally known as "Pahadi," and Wild Boar (*Sus scrofa*), both involved in crop depredation conflicts. Predatory species such as the Golden Jackal (*Canis aureus*) were also observed, serving as scavengers and secondary predators.

Unpredictable weather conditions limited observations of reptiles, arthropods, and amphibians. However, authorities reported prominent snake sightings during the rainy season in the core.

The findings from this study underscore the ecological significance of the area, showcasing its potential as a haven for biodiversity across various interconnected habitats. The core zone supports a diverse range of avifaunal and mammalian species, benefiting from urban adaptations and the presence of protected landscapes. Endangered species such as the Egyptian Vulture and Woolly-necked Stork reinforce the critical importance of conserving these habitats.

Table 3: Summary of Findings (Fauna)

Sr. no.	Taxon	Number of Species		
		Core	Buffer	Study Area
1	Birds	38	50	55
2	Butterfly	01	02	03
3	Mammals	04	04	07
4	Herpetofauna	00	02	02

4.3.1 Birds

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	IUCN STATUS	MIGRATORY STATUS	WPA, 2022 (SCHEDULE)	CORE	BUFFER
1.	*Accipiter badius*	Shikra	Accipitridae	LC	R	II	-	+
2.	*Elanus caeruleus*	Black-winged Kite	Accipitridae	LC	R	II	-	+
3.	*Milvus migrans*	Black Kite	Accipitridae	LC	R	-	+	+
4.	*Gyps fulvus*	Griffon Vulture	Accipitridae	LC	R & W	I	+	+
5.	*Neophron percnopterus*	Egyptian Vulture	Accipitridae	EN	W	I	+	+
6.	*Acrocephalus stentoreus*	Clamorous Reed-warbler	Acrocephalidae	LC	R	II	-	+
7.	*Alcedo atthis*	Common Kingfisher	Alcedinidae	LC	R	II	-	+
8.	*Halcyon smyrnensis*	White-breasted Kingfisher	Alcedinidae	LC	R	II	-	+
9.	*Anas poecilorhyncha*	Indian Spot-billed Duck	Anatidae	LC	R	II	-	+
10.	*Ardea intermedia*	Intermediate Egret	Ardeidae	LC	R	II	+	+
11.	*Ardeola bacchus*	Chinese Pond-heron	Ardeidae	LC	-	II	+	+
12.	*Ardeola grayii*	Indian Pond-heron	Ardeidae	LC	R	II	+	+
13.	*Bubulcus ibis*	Cattle Egret	Ardeidae	LC	R	II	+	+
14.	*Egretta garzetta*	Little Egret	Ardeidae	LC	R	II	+	+
15.	*Burhinus indicus*	Indian Thick-knee	Burhinidae	LC	R	II	+	-
16.	*Vanellus indicus*	Red-wattled Lapwing	Charadriidae	LC	R	II	+	+
17.	*Ciconia episcopus*	Asian Woollyneck	Ciconiidae	NT	-	II	-	+
18.	*Orthotomus sutorius*	Common Tailorbird	Cisticolidae	LC	R	II	+	+
19.	*Prinia socialis*	Ashy Prinia	Cisticolidae	LC	R	II	+	+
20.	*Columba livia*	Rock Dove	Columbidae	LC	R	-	+	+
21.	*Spilopelia chinensis*	Eastern Spotted Dove	Columbidae	LC	R	II	+	+
22.	*Streptopelia decaocto*	Eurasian Collared-dove	Columbidae	LC	R	II	+	+
23.	*Corvus macrorhynchos*	Large-billed Crow	Corvidae	LC	R	II	+	+
24.	*Corvus splendens*	House Crow	Corvidae	LC	R	II	+	+
25.	*Dendrocitta vagabunda*	Rufous Treepie	Corvidae	LC	R	II	+	+
26.	*Centropus sinensis*	Greater Coucal	Cuculidae	LC	R	II	+	+
27.	*Eudynamys scolopaceus*	Western Koel	Cuculidae	LC	R	II	+	+

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	IUCN STATUS	MIGRATORY STATUS	WPA, 2022 (SCHEDULE)	CORE	BUFFER
28.	*Dicrurus macrocercus*	Black Drongo	Dicruridae	LC	R	II	+	+
29.	*Argya striata*	Jungle Babbler	Leiothrichidae	LC	W	II	+	+
30.	*Argya malcolmi*	Large Grey Babbler	Leiothrichidae	LC	R	II	+	+
31.	*Psilopogon zeylanicus*	Brown-headed Barbet	Megalaimidae	LC	R	II	+	-
32.	*Motacilla alba*	White Wagtail	Motacillidae	LC	W	II	+	+
33.	*Copsychus saularis*	Oriental Magpie-robin	Muscicapidae	LC	R	II	+	+
34.	*Ficedula parva*	Red-breasted Flycatcher	Muscicapidae	LC	R	II	+	-
35.	*Oenanthe fusca*	Brown Rockchat	Muscicapidae	LC	R & W	II	+	-
36.	*Oenanthe isabellina*	Isabelline Wheatear	Muscicapidae	LC	W	II	+	-
37.	*Saxicola maurus*	Siberian Stonechat	Muscicapidae	-	R & W	II	-	+
38.	*Saxicoloides fulicatus*	Indian robin	Muscicapidae	LC	R	II	+	+
39.	*Cinnyris asiaticus*	Purple Sunbird	Nectariniidae	LC	W	II	+	+
40.	*Phalacrocorax fuscicollis*	Indian Cormorant	Phalacrocoracidae	LC	R	II	+	+
41.	*Pavo cristatus*	Indian Peafowl	Phasianidae	LC	R	I	-	+
42.	*Tachybaptus ruficollis*	Little Grebe	Procellariidae	LC	R	II	-	+
43.	*Alexandrinus krameri*	Rose-ringed Parakeet	Psittaculidae	LC	R	II	+	+
44.	*Palaeornis eupatria*	Alexandrine Parakeet	Psittaculidae	NT	R	II	+	+
45.	*Pycnonotus cafer*	Red-vented Bulbul	Pycnonotidae	LC	R	II	+	+
46.	*Pycnonotus jocosus*	Red-whiskered Bulbul	Pycnonotidae	LC	R	II	-	+
47.	*Amaurornis phoenicurus*	White-breasted Waterhen	Rallidae	LC	R	II	-	+
48.	*Gallinula chloropus*	Common Moorhen	Rallidae	LC	-	II	-	+
49.	*Himantopus himantopus*	Black-winged Stilt	Recurvirostridae	LC	W	II	-	+
50.	*Actitis hypoleucos*	Common Sandpiper	Scolopacidae	LC	R	II	-	+
51.	*Acridotheres ginginianus*	Bank Myna	Sturnidae	LC	R	II	+	+
52.	*Acridotheres tristis*	Common Myna	Sturnidae	LC	R	II	+	+
53.	*Gracupica contra*	Asian Pied Starling	Sturnidae	LC	R	II	+	+
54.	*Sturnia pagodarum*	Brahminy Starling	Sturnidae	LC	R	II	-	+
55.	*Pseudibis papillosa*	Red-naped Ibis	Threskiornithidae	LC	R	II	-	+

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	IUCN STATUS	MIGRATORY STATUS	WPA, 2022 (SCHEDULE)	CORE	BUFFER

Note:
I, II, III: Schedules of Wildlife Protection (Amendment) Act, 2022
LC: Least Concern; EN: Endangered; NT: Near Threatened
R: Resident; W: Winter Migrant

4.3.2 Butterflies

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	IUCN STATUS	WPA, 2022 (SCHEDULE)	CORE	BUFFER
1.	*Belenois aurota*	Pioneer White	Pieridae	LC	-	-	+
2.	*Zizeeria karsandra*	Dark Grass Blue	Lycaenidae	-	-	+	-
3.	*Danaus chrysippus*	Plain Tiger	Nymphalidae	-	-	-	+

Note:
LC: Least Concern

4.3.3 Mammals

S. NO.	SCIENTIFIC NAME	COMMON NAME	FAMILY	IUCN STATUS	WPA, 2022 (SCHEDULE)	Core	Buffer
1.	*Macaca mulatta*	Rhesus Macaque	Cercopithecidae	LC	-	+	+
2.	*Herpestes edwardsii*	Indian Grey Mongoose	Herpestidae	LC	I	+	-
3.	*Funambulus palmarum*	Common Palm Squirrel	Sciuridae	LC	-	+	-
4.	*Pipistrellus pipistrellus*	Common Pipistrell	Vespertilionidae	LC	-	+	-
5.	*Boselaphus tragocamelus**	Nilgai	Bovidae	LC	II	-	+
6.	*Canis aureus**	Golden Jackal	Canidae	LC	I	-	+

Note:
LC: Least Concern
I, II: Schedules of Wildlife Protection (Amendment) Act, 2022
*: Secondary data

4.3.4 Herpetofauna

S. NO.	SCIENTIFIC NAME	COMMON NAME	FAMILY	IUCN STATUS	WPA, 2022 (SCHEDULE)	Core	Buffer
1.	*Fowlea piscator*	Chequered Keelback	Natricidae	LC	-	-	+
2.	**Naja naja*	Indian Cobra	Elapidae	LC	-	-	+

Note:
LC: Least Concern
*: Secondary data

4.4 Quantitative Assessment

4.4.1 Shannon-Wiener Diversity Index

One tool for assessing the species diversity in a community is the Shannon Diversity Index, also known as the Shannon-Wiener Index. This index, represented by the letter H, is computed as follows: H = -Σpi * ln(pi). The species diversity in a given community increases with a greater value of H. The diversity decreases as the value of H decreases. A community with only one species is indicated by a value of H = 0.

Shannon-Wiener Diversity Index falls between 0 and 5.

4.4.1.1 Flora

Shannon-Wiener diversity index value for the flora is depicted below:

Table 4: Shannon-Wiener diversity Index (Flora)

	Sampling point	Latitude	Longitude	Trees	Shrubs	Climbers	Herbs
CORE	D1 P1 C	27.95894	78.09918	0.35	0.60	0.00	1.76
	D1 P2 C	27.95902	78.09999	2.15	0.00	0.00	1.47
	D1 P3 C	27.9576	78.09855	1.17	0.50	0.00	0.39
BUFFER	D1 P4 B	27.95415	78.08577	1.01	1.05	0.64	1.22
	D1 P4 B	27.96238	78.09348	0.69	0.00	1.06	1.44
	D2 P1 B	27.9576	78.09855	1.04	0.56	0.00	1.50
	D2 P2 B	27.95814	78.10445	1.28	0.00	0.00	1.25
	D2 P3 B	27.9558	78.10276	0.00	0.00	0.00	1.94
	D2 P4 B	27.97246	78.09549	1.26	1.01	0.60	1.65
	D2 P5 B	27.94471	78.0973	0.00	0.00	0.56	0.35
	D2 P6 B	27.96573	78.1028	1.67	0.64	0.00	0.49

4.4.1.2 Fauna

Shannon-Wiener diversity index value for the fauna is depicted below:

Table 5: Shannon-Wiener diversity Index (Fauna)

	Sampling point	Latitude	Longitude	Birds	Mammals
CORE	D1 P1 C	27.95894	78.09918	2.53	0.68
	D1 P2 C	27.95902	78.09999	0.23	0.00

BUFFER	D1 P3 C	27.9576	78.09855	2.31	0.69
	D1 P4 B	27.95415	78.08577	1.49	0.00
	D1 P4 B	27.96238	78.09348	2.23	0.00
	D2 P1 B	27.9576	78.09855	1.93	0.00
	D2 P2 B	27.95814	78.10445	2.57	0.00
	D2 P3 B	27.9558	78.10276	1.73	0.00
	D2 P4 B	27.97246	78.09549	1.75	0.00
	D2 P5 B	27.94471	78.0973	2.00	0.00
	D2 P6 B	27.96573	78.1028	2.17	0.00

4.4.2 Simpson's Diversity Index

Simpson's Biodiversity Index considers the dominance of species in a community. It is based on the probability that two individuals randomly selected from the community belong to the same species. A community dominated by one or two species is less diverse than one in which several different species have a similar abundance.

As species richness and evenness increase, the value of the indices also increases. The index ranges from 0 to 1, where:

D = 0 indicates minimum diversity, where a single species dominates the entire community (maximum dominance).

D = 1 indicates infinite diversity, meaning all species are equally abundant (perfect evenness).

4.4.2.1 Flora

The Simpson's diversity index value for the flora is depicted below:

Table 6: Simpson's diversity Index (Flora)

	Sampling point	Latitude	Longitude	Trees	Shrubs	Climbers	Herbs
CORE	D1 P1 C	27.95894	78.09918	0.22	0.48	0.00	0.79
	D1 P2 C	27.95902	78.09999	0.96	0.00	0.00	0.72
	D1 P3 C	27.9576	78.09855	0.69	0.40	0.00	0.19
	D1 P4 B	27.95415	78.08577	0.73	0.80	0.67	0.62
BUFFER	D1 P4 B	27.96238	78.09348	1.00	0.00	0.72	0.69
	D2 P1 B	27.9576	78.09855	0.71	0.50	0.00	0.67
	D2 P2 B	27.95814	78.10445	0.81	0.00	0.00	0.56
	D2 P3 B	27.9558	78.10276	0.00	0.00	0.00	0.81
	D2 P4 B	27.97246	78.09549	0.76	0.73	0.48	0.69

	D2 P5 B	27.94471	78.0973	0.00	0.00	0.50	0.16
	D2 P6 B	27.96573	78.1028	0.82	0.48	0.00	0.20

4.4.2.2 Fauna

The Simpson's diversity index value for the fauna is depicted below:

Table 7: Simpson's diversity Index (Fauna)

Sampling point		Latitude	Longitude	Birds	Mammals
CORE	D1 P1 C	27.95894	78.09918	0.90	0.57
	D1 P2 C	27.95902	78.09999	0.12	0.00
	D1 P3 C	27.9576	78.09855	0.89	0.67
	D1 P4 B	27.95415	78.08577	0.80	0.00
	D1 P4 B	27.96238	78.09348	0.88	0.00
BUFFER	D2 P1 B	27.9576	78.09855	0.81	0.00
	D2 P2 B	27.95814	78.10445	0.92	0.00
	D2 P3 B	27.9558	78.10276	0.82	0.00
	D2 P4 B	27.97246	78.09549	0.83	0.00
	D2 P5 B	27.94471	78.0973	0.88	0.00
	D2 P6 B	27.96573	78.1028	0.83	0.00

5 BIODIVERSITY IMPACT AND DEPENDENCIES

5.1 Inventory of Impact and Dependencies

Table 8: Dependency and Impact Matrix of Ecosystem Services

Company: Zydus Wellness Limited, Aligarh **Assessment scope:** Company operations **Product:** Fast-Moving Consumer Goods		***Company DEPENDENCE on ecosystem services***			***Company IMPACT on ecosystem services***			
Ecosystem services	**Definitions**	1.Does this ecosystem service serve as an input or does it enable/ enhance conditions for successful company performance? If "no" skip to question 3	Does this ecosystem service have service have cost-effective substitutes?	Comments or supporting information	3. Does the company affect the quantity or quality of this ecosystem service? *If "no" skip to the next ecosystem service*	4. Is the company's impact positive or negative? - Positive: The company increases the quantity or quality of this ecosystem service - Negative: The company decreasesthe quantity or quality of this ecosystem service	5. Does the company's impact limit or enhance the ability of others to benefit from this ecosystem service?	**Comments or supporting information**
PROVISIONAL SERVICES								
Biomass fuel	Biological material derived from living or recently living organisms–both plant and animal–that serves as a source of energy.	Y	Y	Rice husk is used as fuel in the operation. These are produced using natural agricultural waste and hence is an efficent solution to reducing dependency on non-conventional sources.	N			
Freshwater	Inland bodies of water, groundwater, rainwater, and surface waters for household, industrial, and agricultural uses.	Y	N	The water is sourced from three existing borewell for domestic and commercial use. The unit discharges the treated water that remains in excess after the amount consumed for green belt development, in designated drain.	N			The instalelled Effluent Treatment Plant (ETP) produces 700-750 KLD of treated water that comply with the requirements of the pollution control board, out of which 350-500 KLD of the treated water is used for watering the green belt, while the remaining is released in a drain.
REGULATING SERVICES								
Maintenance of air quality	Influence ecosystems have on air quality by emitting chemicals to the atmosphere (i.e., serving as a “source”) or extracting chemicals from the atmosphere (i.e., serving as a “sink”).	Y	Y	Forest act as a sink for Carbon dioxide and many other harmful pollutants. Though the operation adheres to the laws of the national/ state pollution control board, the residual emissions are absorbed the surrounding forest area.	N			All the emissions in the operations are undertaken within the permissible limit of the state pollution control board.
Global climate regulation	Influence ecosystems have on the global climate by emitting greenhouse gases or aerosols to the atmosphere or by absorbing greenhouse gases or aerosols from the atmosphere.	Y	N	The company emits several green house gases and currently it is planning to become a carbon neutral operation. The dependency of the company is high on this service as it is a requirement for the regulatory and reputational purpose.	N			

Company:	Zydus Wellness Limited, Aligarh	***Company DEPENDENCE on ecosystem services***			***Company IMPACT on ecosystem services***			
Assessment scope:	Company operations							
Product:	Fast-Moving Consumer Goods							
Ecosystem services	**Definitions**	1.Does this ecosystem service serve as an input or does it enable/ enhance conditions for successful company performance? If "no" skip to question 3	Does this ecosystem service have service have cost-effective substitutes?	Comments or supporting information	3. Does the company affect the quantity or quality of this ecosystem service? *If "no" skip to the next ecosystem service*	4. Is the company's impact positive or negative? - Positive: The company increases the quantity or quality of this ecosystem service - Negative: The company decreasesthe quantity or quality of this ecosystem service	5. Does the company's impact limit or enhance the ability of others to benefit from this ecosystem service?	**Comments or supporting information**
Regulation of water timing and flows	Influence ecosystems have on the timing and magnitude of water runoff, flooding, and aquifer recharge, particularly in terms of the water storage potential of the ecosystem or landscape.	Y	N	The company depends heavily upon the available groundwater that recharges naturally and efficiently. Although the availability of ground water is consistent throughout the past years, limitation or changes in this service might cause hindrance in its operations.	N			

The study highlights that the operation is highly dependent on freshwater for its operation. Additionally, it is also dependendt on other regulating services related to climate, air quality and water timing and flows.

Table 9: Summary of Priority Ecosystem Services

Ecosystem services		Dependency	Impact
Provisioning			
1	Biomass fuel	○	
2	Freshwater	●	
Regulating			
3	Maintenance of air quality	○	
4	Global climate regulation	●	
5	Regulation of water timing and flows	●	
Key ● **High** ○ **Medium** **Low**		**+ Positive impact** **- Negative impact** **? Don't know**	

5.2 Inventory of Biodiversity Impacts

Following impcts were observed associared to biodiversity:

Sr. no.	Type of Impact	Details
1	Direct	Utilization of water resources may increase demand and may lead to its depletion
2	Indirect	Emission from the operation or vehicular movement may lead to increased pollutants in the environment
3	Direct	Presence of invasive species in the plant area may lead to its dispersal in other parts replacing the native flora of the site and surrounding
4	Indirect	Disposal of debris in plant areas may provide hideouts for snakes leading to more encounters with humans
5	Indirect	Presence of pigeons in the area may lead to spreading zoonotic diseases and contamination

6 BIODIVERSITY MANAGEMENT PLAN

6.1 Objective

The Biodiversity Management Plan (BMP) aims to reduce the impact of the operation process on the biodiversity of the study area to achieve 'No-net Loss'. Following objectives needs to be adopted to sustain the biodiversity of the area in association with the operation:

- Education, awareness, and involvement of stakeholders in the protection of biodiversity
- Conservation and enhancement of the habitat
- Increase Biodiversity Value of the Site
- Reduce Threats on the Biodiversity
- Maintain a database and reporting biodiversity related measures in public domain

6.2 Path to No-net Loss

A mitigation hierarchy (Avoidance-Minimisation-Restoration-Biodiversity Offset). Conservation initiatives and actions that aid in the process of species conservation and enhancing the habitat can contribute towards achieving No-net Loss.

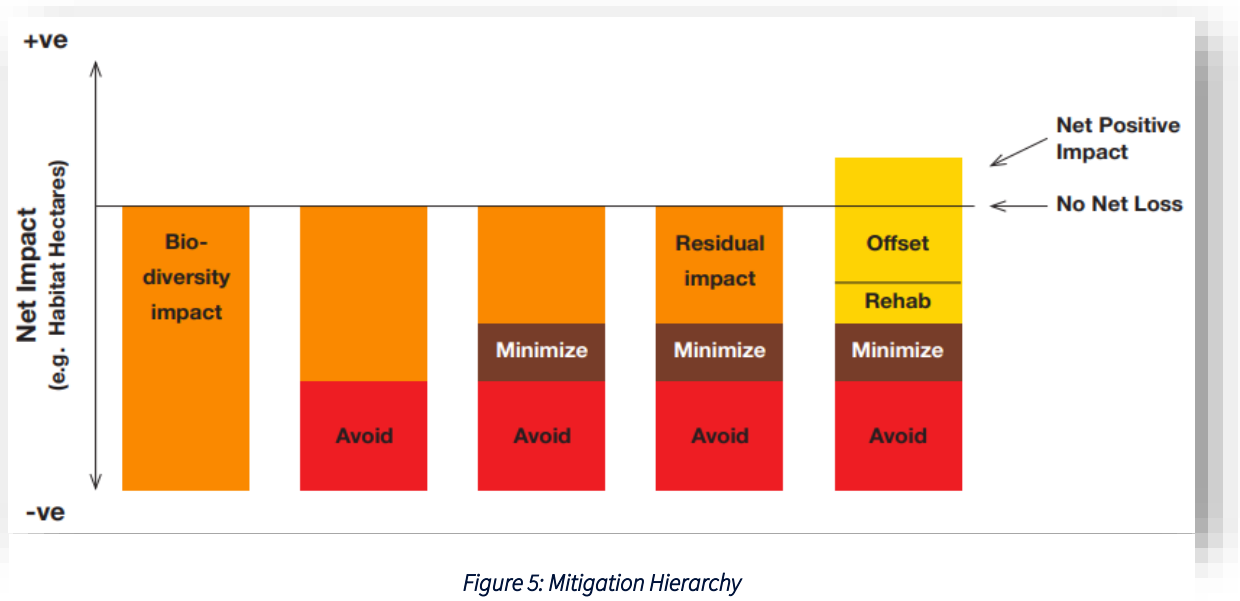

Figure 5: Mitigation Hierarchy

Impact and Dependencies of the operation on Biodiversity and Ecosystem Services were identified. Based on the biodiversity risk of each impact, a mitigation category has been assigned to the impacts and the strategies and action plans have been suggested accordingly.

Table 10: Corelation between the impacts and mitigation hierarchy

Impacts	Description of the Impact	Mitigation Hierarchy
Impact 1	Utilization of water resources may increase demand and may lead to its depletion	**Minimization**

Impacts	Description of the Impact	Mitigation Hierarchy
Impact 2	Emission from the operation or vehicular movement may lead to increased pollutants in the environment	**Minimize**
Impact 3	Presence of invasive species in the plant area may lead to its dispersal in other parts replacing the native flora of the site and surrounding	**Minimization + Restoration**
Impact 4	Disposal of debris in plant areas may provide hideouts for snakes leading to more encounters with humans	**Avoidance**
Impact 5	Presence of pigeons in the area may lead to spread of diseases and increase chances of contamination	**Minimization**

6.3 Strategies and Action Plans

6.3.1 Biodiversity Management System

Concept/Requirement

A comprehensive Biodiversity Management System can be established on group level to oversee the preservation of biodiversity both within the plant as well as its surrounding habitats. This system should consist of members with diverse expertise in Biodiversity and Environmental Management. Additionally, the creation of this system should be accompanied by a well-designed training program that encompasses the necessary tasks and functions for its effective operation.

The BMS should have protocols for data collection, compilation, and evaluation, and maintaining a consistent database. On unit level a Biodiversity Champion should be engage for taking ownership and responsibility for biodiversity, facilitated by foundational knowledge gained through various training and awareness programs.

Role of Biodiversity Management System

The Biodiversity Champion will undertake the following responsibilities:

- Overseeing the successful execution of the Biodiversity Action Plan
- Tracking the advancement of the Biodiversity Action Plan's implementation
- Conducting biodiversity awareness sessions for employees and colleagues
- Establishing an accessible information-sharing platform
- Managing, executing, and overseeing the 'Biodiversity Protocols and Procedures' outlined below.

Significance	• Active participation of employees and locals in conservation of habitats and species • Providing opportunities to talent driven individuals

6.3.2 Enhancing Education and Awareness related to Biodiversity

6.3.2.1 Awareness about Biodiversity

Preserving biodiversity of an area necessitates the participation of every segment of the community. Building awareness about the local biodiversity, wildlife population dynamics, and the human-induced threats they face is vital to engage communities actively in conservation efforts.

The percentage of the employees sensitised on biodiversity and ecosystem services during reporting period should be indicated. The following formula can be used for calculation.

$$Percentage\ of\ employees\ sensitized\ on\ biodiversity = \frac{Total\ number\ of\ employees\ sensitized}{Total\ Employees} \times 100$$

Based on the qualification and managerial level, the employees can be divided into different groups and accordingly the sessions can be arranged.

6.3.2.2 Capacity Building Sessions

Concept/ Requirement

To conserve biodiversity effectively, it's crucial to first understand and recognize its significance. Often, the richness of flora and fauna compositions in our surroundings goes unnoticed until a situation demands attention. Therefore, raising awareness among both employees and citizens about local biodiversity and its vital role in human well-being is essential for its preservation.

Implementation Measures

- One of the ways through which awareness can be achieved is by conducting capacity building sessions, wherein the locals are directly or through indirect means like photographs are introduced to the local biodiversity. This can be done through following techniques:
- Conducting introductory workshops that will showcase interesting images of habitats and existing biodiversity.
- Celebrating a yearly “Biodiversity Festival” that will closely involve practitioners, NGOs, students, locals, and talent driven individuals. Through the festival, biodiversity of the region can be showcased with present state, impacts, mitigation efforts taken by the operation towards conservation.
- Identifying talented individuals and involve them in conservation and monitoring efforts.
- Support and encourage improved training and professional development for teachers, employees and others involved in building awareness about biodiversity.

- Conducting Nature trails in the different habitats and biodiverse regions in the study area.

Significance	• Active participation of employees and locals in conservation of habitats and species • Providing opportunities to talent driven individuals

6.3.2.3 Installation of Biodiversity Information Posters in the Study area

Concept/ Requirement

Posters and signage carrying information of the existing biodiversity in the core, as well as the study area, will take the work of capacity building sessions a step further, regularly exposing the residents to their biodiversity. Along with displaying specific important species found in the study area, these signage boards will also hold information on the importance of the dominant natural habitat of the study area especially the forest species. Impact of human activities on scrublands and their species and measures to reduce this impact and conserve the habitat will be displayed on these installations. Installation of graphical signages in the local languages along with awareness sessions for the residents in their surroundings is essential for the purpose of awareness.

Figure 6: Representative Image of Information Board

Examples of Poster for the Aligarh Plant:

1. Birds in the plant area
2. Native flora of Aligarh
3. Vulture species in Aligarh
4. Importance of Biodiversity Conservation
5. Human- Biodiversity Relationship

Significance	Biodiversity Awareness among employees and locals regarding local biodiversity and contribution in their conservation

6.3.2.4 Celebration of 25 Wildlife and Environmental days

Concept/ Requirement

International organizations and agencies dedicated some days in the year to various biodiversity and various elements of the environment. These days aim to create awareness and encourage public action for conservation.

Organizing events to celebrate these days sustainably supports the aim of generating awareness about the environment, biodiversity and its conservation. The celebration can be marked by the conduction of talks by experts on the theme of the day, organization of relevant activities like nature trails, competitions and drives to create protect or clean habitats, etc. The employees, students and residents of the unit should be informed of these events and their participation should be encouraged and rewarded. CSR-driven initiatives like awards and scholarships to the most sustainable and environmentally aware village/community in the study area and students actively participating in events organized to create awareness and conserve the biodiversity of the region.

Date	Days related to Biodiversity/ Environment
2nd February	World Wetland Day
14th March	International Day of Action for Rivers
20th March	World Sparrow Day
22nd April	Earth Day
22nd May	World Biodiversity Day
5th June	World Environment Day
1st July to 7th July	Van Mahotsava Saptah
23rd September	World River Day
1st October to 7th October	Wildlife Week
3rd October	World Habitat Day
12th October	World Migratory Bird Day
21st November	World Fisheries Day
5th December	World Soil Day

Significance	Awareness among employees and locals regarding local biodiversity and contribution in their conservation

6.3.2.5 Integration of QR Code/ Label for the Awareness and Management of Tree Species in the Plant Area

Concept/ Requirement

With the rapid advancement of technology, the integration of innovative tools such as Quick Response (QR) codes offers a promising avenue to enhance educational experiences, particularly in the study of diverse tree species. This initiative aims to explore the potential of using QR codes to provide comprehensive information about various trees located within the core area of

QR codes have already proven to be an efficient method for tracking and managing assets in large-scale operations across multiple sectors. In the context of a plant manufacturing unit, QR coding of trees can significantly contribute to enhancing sustainability, improving the management of green cover, and promoting environmental responsibility. In India, where biodiversity preservation is a growing concern, this technology can play a crucial role in protecting and monitoring native tree species within industrial premises.

The use of QR codes for environmental education and biodiversity conservation is gaining traction in India. For instance, New Delhi Municipal Corporation has installed QR codes on almost 4,000 trees in in Major Gardens, Avenues, Markets and NDMC Schools to highlight their ecological, medicinal, and religious significance (Daily Excelsior), through India's first ecology based environmental consultancy – Terracon Ecotech Private Limited.

Implementation Measures

Steps for Implementing Tree QR Coding:

1. **Inventory & Mapping**
   - Start by identifying and mapping all trees within the premises.
   - This process should include recording the GPS coordinates of each tree, along with data on its species, age, and current health status.
2. **Selection of QR Code Technology**
   - Choose a QR code platform that supports integration with a centralized database and offers data analytics capabilities.
   - The platform should be user-friendly, secure, and scalable to meet future requirements.
3. **Tree Labelling:**
   - Generate and print durable QR code labels.
   - Ensure the labels are weather-resistant and designed to withstand harsh environmental conditions.

- Attach the QR codes to trees using non-invasive, tree-friendly materials.

4. **Database Development:**
   - Create a centralized online database to store detailed information on each tree, such as growth metrics, species, health logs, and any maintenance or interventions (e.g., pruning or disease treatment).
5. **Integration with Environmental Reports**
   - Incorporate the collected tree data into regular environmental reports for stakeholders, including governmental bodies, local NGOs, and corporate sustainability teams.
6. **Continuous Monitoring & Maintenance:**
   - Establish a periodic review process to monitor tree health and ensure that the QR code system is updated regularly to reflect any changes.

Draft design for tree label with QR code

The following image illustrates a sample draft design of a tree label featuring a QR code:

Figure 7: Draft design for tree label with QR code (Representative Picture)

Information to be displayed upon scanning the QR Code:

- Botanical Name
- Common Name (English and Local)

- General description of the plant including their biogeographical region, habit, IUCN status, and its special characters & phenology
- Ecological Significance (5-6 lines)
- Medicinal Uses (5-6 lines)

6.3.3 Enhancement of Greenbelt through inclusion of Native Species

Concept/ Requirement

Native plants are an important part of our natural heritage. Ecological approach should be adopted while enhancing biodiversity of any area. Even just a modest number of native plants in an area provide far better food, shelter, and nesting for local wildlife than any kind of non-native plant can. Most types of butterflies, other pollinators, and many mammals and insects depend on very specific native plant varieties for their survival. This fosters a healthy, balanced ecosystem which is more resistant to damage by pests and diseases (Ozyavuz, 2013).

Upon analysing the species composition at the Zydus Wellness, Aligarh unit, it was inferred that most of the ornamental species observed in the horticultural garden were exotic in origin. To promote sustainability and conservation, it is advisable to prioritize the inclusion of native species in higher frequency and density to maintain a suitable environment.

Implementation Measures

Particulars	Details
Diverse Native Flora Collections	➢ Continuously expand and diversify the plant collections to showcase a wide range of botanical specimens, including RET (rare endangered threatened plants), common native species, and plants with cultural and ethnobotanical significance. Use striking name boards for each species.
Maintain Data Fidelity	➢ Cross-verify the scientific names and common names of all the species under cultivation by referring to proper scientific websites; (https://indiabiodiversity.org), (http://www.flowersofindia.net), (https://bsi.gov.in) etc.
Long-Term Maintenance and Sustainability	➢ LTM involves the periodic maintenance of the health of flora species and garden premises to maintain its sustainability ➢ Practice sensible and environmentally friendly measures like; organic gardening, composting and using drip irrigation systems, thus maintaining the soil microbiota health and utilizing less water resources
Conservation Initiatives	➢ Practice plant conservation initiatives, such as ethnomedicinal seed banking, Rare Endangered and Threatened (RET) plant propagation, and native endangered species conservation

Based on the biogeographical area, and vegetation, the following enlisted species can be utilized to establish native species diversity:

Table 11: List of Species suggested for Greenbelt Enhancement

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	IUCN STATUS	VEGETATION TYPE
Trees					
1	*Ailanthus excelsa*	Tree of Heaven	Simaroubaceae	DD	Deciduous
2	*Albizia procera*	White Siris	Fabaceae	LC	Deciduous
3	*Albizia lebbeck*	Indian Siris	Fabaceae	LC	Deciduous
4	*Alstonia scholaris*	Scholar tree	Apocynaceae	LC	Evergreen
5	*Aegle marmelos*	Wood Apple	Rutaceae	NT	Deciduous
6	*Azadirachta indica*	Margosa tree	Meliaceae	LC	Evergreen (semi-deciduous)
7	*Bauhinia racemosa*	Bidi leaf tree	Fabaceae	LC	Deciduous
8	*Butea monosperma*	Flame of the Forest	Fabaceae	LC	Deciduous
9	*Caryota urens*	Fishtail palm	Arecaceae	LC	Evergreen
10	*Cassia fistula*	Golden Shower Tree	Fabaceae	LC	Deciduous
11	*Cordia dichotoma*	Indian Cherry	Boraginaceae	LC	Deciduous
12	*Dalbergia sissoo*	Indian Rosewood	Fabaceae	LC	Deciduous
13	*Ficus palmata*	Punjab Fig	Moraceae	LC	Deciduous
14	*Fernandoa adenophylla*	Katsagon	Bignoniaceae	LC	Deciduous
15	*Holoptelea integrifolia*	Indian Elm	Ulmaceae	LC	Deciduous
16	*Lagerstroemia speciosa*	Queen's Crape Myrtle	Lythraceae	LC	Deciduous
17	*Melia azedarach*	Chinaberry tree	Meliaceae	LC	Deciduous
18	*Mitragyna parvifolia*	Kaim	Rubiaceae	LC	Deciduous
19	*Moringa oleifera*	Drumstick tree	Moringaceae	LC	Deciduous
20	*Morus alba*	Mulberry	Moraceae	LC	Evergreen (semi-deciduous)
21	*Murraya koenigii*	Curry Leaf tree	Rutaceae	LC	Evergreen
22	*Nyctanthes arbor-tristis*	Queen of the night	Oleaceae	LC	Evergreen
23	*Phyllanthus emblica*	India Gooseberry	Phyllanthaceae	LC	Deciduous
24	*Polyalthia longifolia*	Mast tree	Annonaceae	LC	Evergreen
25	*Pongamia pinnata*	Pongam tree	Fabaceae	LC	Evergreen
26	*Syzygium cumini*	Java plum	Myrtaceae	LC	Evergreen
27	*Tectona grandis*	Teak	Verbenaceae	EN	Deciduous
28	*Vachellia nilotica*	Babool	Mimosaceae	LC	Deciduous
Shrubs					
1	*Abutilon indicum,*	Indian Mallow	Malvaceae	-	Perennial
2	*Lawsonia inermis*	Henna	Lythraceae	LC	Perennial
3	*Nerium oleander*	Oleander	Apocynaceae	LC	Perennial
4	*Phyllanthus reticulatus*	Black Honey shrub	Phyllanthaceae	LC	Perennial
5	*Plumbago zeylanica*	Chitrak	Plumbaginaceae	-	Perennial

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	IUCN STATUS	VEGETATION TYPE
Climbers					
1	*Cocculus hirsutus*	Broom creeper	Menispermaceae	-	Perennial
2	*Combretum indicum*	Burma creeper	Combretaceae	-	Perennial
3	*Merremia hederacea*	Ivy Woodrose	Convolvulaceae	-	Perennial
4	*Momordica charantia*	Bitter melon	Cucurbitaceae	-	Annual
5	*Oxystelma esculentum*	Rosy Milkweed vine	Apocynaceae	LC	Perennial
6	*Pergularia daemia*	Pergularia	Asclepiadaceae	LC	Perennial
7	*Teramnus labialis*	Mashparui	Fabaceae	-	Annual/Perennial
8	*Trichosanthes cucumerina*	Snake gourd	Cucurbitaceae	-	Annual
Herbs & Grasses					
1	*Acalypha indica*	Indian Copperleaf	Euphorbiaceae	-	Annual
2	*Anisomeles indica*	Indian Catmint	Lamiaceae	-	Annual/Perennial
3	*Bassia scoparia*	Burningbush	Amaranthaceae	-	Annual
4	*Chrysopogon zizanioides*	Golden Beardgrass	Poaceae	-	Perennial
5	*Chloris barbata*	Swollen Fingergrass	Poaceae	-	Perennial
6	*Cyanthillium cinereum*	Little Ironweed	Asteraceae	-	Annual
7	*Cymbopogon citratus*	Lemon grass	Poaceae	-	Perennial
8	*Cynodon dactylon*	Bermuda grass	Poaceae	-	Perennial
9	*Dactyloctenium aegyptium*	Crowfoot grass	Poaceae	-	Perennial
10	*Dichanthium annulatum*	Marvel Grass	Poaceae	-	Annual
11	*Dicliptera paniculata*	Panicled Foldwing	Acanthaceae	-	Perennial
12	*Eragrostis tenella*	Japanese Lovegrass	Poaceae	-	Annual
13	*Euphorbia granulata*	Prostrate Spurge	Euphorbiaceae	-	Annual
14	*Glinus lotoides*	Damascisa	Molluginaceae	LC	Annual
15	*Lemna minor*	Duckweed	Araceae	LC	Perennial
16	*Ludwigia perennis*	Perennial Water Primrose	Onagraceae	LC	Annual
17	*Mazus pumilus*	Asian mazus	Phrymaceae	-	Annual
18	*Melilotus indicus*	Sweet clover	Fabaceae	-	Annual/Biennial
19	*Ocimum americanum*	Wild Basil	Lamiaceae	-	Annual
20	*Ocimum tenuiflorum*	Holy Basil	Lamiaceae	-	Perennial
21	*Persicaria hydropiper*	Water Pepper	Polygonaceae	LC	Annual
22	*Polygonum plebeium*	Small Knotweed	Polygonaceae	LC	Annual
23	*Setaria verticillata*	Bristly Foxtail	Poaceae	-	Annual
24	*Sida acuta*	Common Wireweed	Malvaceae	-	Perennial

SN	SCIENTIFIC NAME	COMMON NAME	FAMILY	IUCN STATUS	VEGETATION TYPE
25	*Sida cordata*	Heart-leaf Sida	Malvaceae	-	Perennial
26	*Solanum nigrum*	Black Nightshade	Solanaceae	-	Annual/Perennial
27	*Sonchus asper*	Prickly Sow-Thistle	Asteraceae	-	Annual/Biennial
28	*Spergula arvensis*	Corn Spurry	Caryophyllaceae	-	Annual
29	*Veronica anagallis-aquatica*	Blue Water-speedwell	Plantaginaceae	LC	Perennial

6.3.4 Invasive Species Management

Concept/Requirement

An invasive species denotes a non-indigenous plant species to a specific region and has been introduced to a new environment, intentionally or unintentionally. This species proliferates rapidly upon introduction, yielding significant ecological, economic, or human health impacts. Owing to the absence of natural predators or competitors, these plants tend to dominate the new environment, often resulting in the displacement of native plant species and the disruption of local ecosystems. A recent report published in the Journal of Applied Ecology indicates that approximately 66 per cent of India's natural ecosystems are at risk from invasive species. This finding results from a comprehensive national-level survey that covered 158,000 plots within 358,000 square kilometres of wild areas. The report underscores that 11 high-concern invasive plant species, including Common Lantana (*Lantana camara*), Mesquite (*Prosopis juliflora*), and Devilweed (*Chromolaena odorata*), have established a presence in 20 states throughout the country.

In urban environments, invasive species represent a significant threat to the conservation of biodiversity and the health of ecosystems. Human activity in these settings creates favourable conditions for the establishment and proliferation of these species. The removal of invasive species is a key management measure for the restoration and preservation of native ecosystems, but it necessitates meticulous planning and prioritization to ensure its effectiveness and efficiency. The control of invasive species populations is vital for the support of local native diversity.

Implementation Measures

On account of winter season baseline data acquisition, the following obnoxious exotic species were specifically identified and observed from the various habitats of the core area,

Table 12: List of Invasive Species observed in the Study area

SN	Scientific Name	Common Name	Family	Origin	IUCN Status	Core	Buffer

Trees							
1	*Spathodea campanulata*	African tulip Tree	Bignoniaceae	Exotic		**N**	**Y**
2	*Ricinus communis*	Castor	Euphorbiaceae	Exotic		**N**	**Y**
3	*Leucaena leucocephala*	Wild tamarind, River tamarind	Fabaceae	Exotic		**Y**	**Y**
4	*Prosopis juliflora*	Algaroba	Fabaceae	Exotic		**Y**	**Y**
5	*Psidium guajava*	Guava	Myrtaceae	Native	Least concern	**Y**	**Y**
Shrubs							
1	*Lantana camara*	Lantana	Verbenaceae	Exotic	-	**N**	**Y**
Climbers							
1	*Coccinia grandis*	Ivy gourd	Cucurbitaceae	Native	-	**Y**	**Y**
Herbs & Grasses							
1	*Alternanthera ficoidea*	Joseph's coat	Amaranthaceae	Exotic	-	**N**	**Y**
2	*Alternanthera sessilis*	Sessile Joyweed	Amaranthaceae	Native	-	**N**	**Y**
3	*Syngonium podophyllum*	Arrowhead plant	Araceae	Exotic	-	**Y**	**N**
4	*Asparagus densiflorus*	Asparagus fern	Asparagaceae	Exotic	-	**Y**	**N**
5	*Furcraea foetida*	Mauritius Hemp	Asparagaceae	Exotic	-	**Y**	**N**
6	*Erigeron bonariensis*	Flax-leaf Fleabane	Asteraceae	Exotic	-	**Y**	**N**
	Parthenium hysterophorus	Carrot grass	Asteraceae	Exotic	-	**Y**	**Y**
7	*Cardamine flexuosa*	Wavy Bittercress	Brassicaceae	Exotic	-	**Y**	**N**
8	*Cannabis sativa*	Hemp	Cannabaceae	Native	-	**N**	**Y**
9	*Tradescantia spathacea*	Oyster plant	Commelinaceae	Exotic	-	**Y**	**N**
10	*Evolvulus nummularius*	Roundleaf Bindweed	Convolvulaceae	Exotic	-	**Y**	**Y**
11	*Eichhornia crassipes*	Water Hyacinth	Pontederiaceae	Exotic	-	**N**	**Y**
12	*Panicum repens*	Torpedo Grass	Poaceae	Native	LC	**N**	**Y**

Table 13. Management plan for invasive species

SN.	Species Name	Observed at locations	Mechanism of spread	Reproduction mechanism	Methods of removal	Methods of disposal	Representative Photo
1	African Tulip Tree (*Spathodea campanulata)*	Buffer area on roadsides	Dispersal of seeds by wind, colonization by root suckers.	Seeds and vegetative	1. Mechanical - Uproot the plants before it sets fruit. 2. As the trees are grown as avenue trees on roadsides, continuous monitoring for seedling growth can check is spread.	1. If the existing individuals are opted for removal, 2. Shredding of all parts. 3. Sun drying for 15 to 20 days. 4. Spreading in plantation site. 5. The wood is difficult to burn and can be used for relevant purposes in fire-prone areas.	
2	Castor (*Ricinus communis*)	Buffer area near croplands	Gravity disperses seeds from the pods when the ripe pods explode open (Institute of Pacific Islands Forestry, 2002). Birds, rodents, other mammals and humans spread the seeds	Seeds	1. Mechanical - Uproot the plants before it sets fruit	1. Shredding of all parts. 2. Sun drying for 15 to 20 days. 3. Spreading in plantation site.	
3	River Tamarind/ Subabool (*Leucaena leucocephala*)	Colony area at the guava orchard.	Mammals, ground insects, water.	Has ability to self-pollinate (promoting seed production even on isolated individuals). Flowering and seeding continually throughout the year as long as moisture permits combined with self-fertility promotes abundant pod and seed set.	1. Mechanical - Uproot the plants before it sets fruit.	1. Shredding of all parts. 2. Sun drying for 15 to 20 days. 3. Spreading in plantation site.	

SN.	Species Name	Observed at locations	Mechanism of spread	Reproduction mechanism	Methods of removal	Methods of disposal	Representative Photo
4	Algaroba (*Prosopis juliflora*)	Jharkhand/ 10-acre rice husk storage area and in the surrounding scrublands.	Dispersal of seeds through frugivorous mammals especially cattle.	Seeds	1. Since the surrounding scrublands comprises exclusively of *Prosopis,* it is not recommended to remove them all at once. 2. Mechanical removal of the trees can be done to reduce their density to 100-400 trees per hectare. 3. In the remaining trees, the side branches must be pruned to leave a single stem. This technique improves the tree and understorey yields.	1. The pods can be fed to cattle, and the produced dung can be mixed with the dried leaves and spines of the tree to make dung cakes. 2. Alternatively, the smaller parts can be shredded, sun dried and spread in the plantation site. 3. The wood can be used as firewood.	
5	*Guava* (*Psidium guajava*)	Gardens and Colony area	Dispersal of seeds through the frugivorous birds and mammals.	Seeds and vegetative.	1. Mechanical - Uproot the plants before it sets fruit. 2. As the fruits are grown for edible purposes in the orchard, any plant found growing outside the orchard area must be transplanted in the orchard.	1. If the existing individuals are opted for removal, 2. Uprooting of plant at nonflowering stage. 3. Shredding of all parts. 4. Sun drying for 15 to 20 days. 5. Spreading in plantation site.	
6	Wild Sage (*Lantana camara*)	Surrounding scrublands	Dispersal of seeds through birds and mammals (sheep, goats, cattles)	Seeds and vegetative.	1. Mechanical - Uproot the plants before it sets fruit.	1. Cut the stems and sun dry them for 15 days or 1 month. Use them as fence material. 2. Alternatively, the thick stems can be boiled, debarked and used for furniture/handicraft. 3. The leaves, spines, smaller twigs, fruits, and flowers can be dried and burnt and used for boiling the stems. 4. Species shows the allelopathic effect. Hence shredding of parts and mixing in soil is not recommended.	

SN.	Species Name	Observed at locations	Mechanism of spread	Reproduction mechanism	Methods of removal	Methods of disposal	Representative Photo
7	Ivy Gourd (*Coccinia grandis*)	In the colony and surrounding scrubland on trees bordering the roads.	Dispersal of seeds through the frugivorous birds and mammals.	Seeds and vegetative.	1. Mechanical - Uproot the plants before it sets fruit. 2. Make sure to remove the tuberous root as well by slight digging.	1. Shredding of all parts. 2. Sun drying for 15 to 20 days. 3. Spreading in plantation site.	
8	Joseph's Coat (*Alternanthera ficoidea*)	Colony, surrounding scrublands and open vegetations.	Dispersal of seeds by wind and water.	Seeds and vegetative.	1. Mechanical - Uproot the plants before it sets fruit.	1. Shredding of all parts. 2. Sun drying for 15 to 20 days. 3. Alternatively, the shredded plants can be sealed in transparent plastic bags and kept in direct sunlight for 15 to 20 days to kill the seeds. 4. Spreading in plantation site.	
9	Sessile Joyweed (Alternanthera sessilis)	Surrounding scrublands	Dispersal of seeds by wind and water.	Seeds and vegetative.	1. Mechanical - Uproot the plants before it sets fruit.	1. Shredding of all parts. 2. Sun drying for 15 to 20 days. 3. Alternatively, the shredded plants can be sealed in transparent plastic bags and kept in direct sunlight for 15 to 20 days to kill the seeds. 4. Spreading in plantation site.	
10	Arrowhead plant (*Syngonium podophyllum*)	Colony, planted as ornamental plant	Intentional or unintentional propagation through cuttings	Vegetative	1. Mechanical - Uproot the plants. 2. As the plants rarely flower, propagation by seeds is not a problem. 3. If the plants are grown ornamentally, its spread must be restricted to the designated areas by uprooting any excessive growths.	1. Shredding of all parts. 2. Sun drying for 15 to 20 days. 3. Spreading in plantation site.	

SN.	Species Name	Observed at locations	Mechanism of spread	Reproduction mechanism	Methods of removal	Methods of disposal	Representative Photo
11	Asparagus fern (*Asparagus densiflorus*)	Colony, planted as ornamental plant	Dispersal of seeds by frugivorous birds.	Seed	1. Mechanical - Uproot the plants before it sets fruit. 2. If the plants are grown ornamentally, the flowering should be monitored and pruned off.	1. Shredding of all parts. 2. Sun drying for 15 to 20 days. 3. Spreading in plantation site	
12	Mauritius Hemp (*Furcraea foetida*)	Lawns near ETP and Administrative building	Fruits are dispersed naturally or by bats.	Seed	1. The plant bears fruits only once in its life after which it dies. 2. To control, uproot the plants when it starts flowering.	1. Shredding of all parts. 2. Sun drying for 15 to 20 days. 3. Spreading in plantation site	
13	Flax-leaf Fleabane (*Erigeron bonariensis*)	Colony near nursery plants	Seeds dispersed by wind, soil movement, water and human activities, rarely by birds.	Seeds, it can self-pollinate and produces numerous seeds.	1. Mechanical - Uproot the plants before it sets fruit.	1. Species shows the allelopathic effect. Hence shredding of parts and mixing in soil is not recommended. 2. Instead, being palatable to grazing animals, it can be fed to cattle or livestock. 3. Alternatively, the plants can be sun dried and burnt off.	
14	Carrot grass (*Parthenium hysterophorus*)	Colony, Jharkhand/ 10-acre rice husk storage area, and surrounding scrublands	Seeds are dispersed by wind, water, or attached to clothes, agricultural machinery, or on animal fur.	Seed and vegetative	1. Mechanical - Uproot the plants before it sets fruit.	1. Uprooting of plant at nonflowering stage. 2. Shredding of all parts. 3. Sundrying for 15 to 20 days. 4. Spreading in plantation site.	

SN.	Species Name	Observed at locations	Mechanism of spread	Reproduction mechanism	Methods of removal	Methods of disposal	Representative Photo
15	Wavy Bittercress (*Cardamine flexuosa*)	Colony lawn	Seeds dispersed by bursting of the pods on maturity. Seeds are sticky when wet and can spread adhered to clothing, footwear or animals.	Seeds, it can self-pollinate and produces numerous seeds.	1. Mechanical - Uproot the plants before it sets fruit.	1. Shredding of all parts. 2. Sun drying for 15 to 20 days. 3. Spreading in plantation site. 4. The seed infested topsoil can be used for landfills or dumps.	
16	Hemp (*Cannabis sativa*)	Surrounding wheat fields	Seeds dispersed naturally around the female plants	Seed. Although the plants are dioecious and hence cannot self-pollinate, the female plants are prolific seeders.	1. Mechanical - Uproot the plants before it sets fruit.	1. The stems can be retted to produce much valuable hemp fibre. 2. The seeds can be collected and used used as birdfeed. 3. Alternatively, the plants can be shredded, soaked in water for 12-24 hours and the water along with the plant waste can be sprayed in plantation site. It acts as a natural pest repellent	
17	Oyster plant (*Tradescantia spathacea*)	Planted as an ornamental near Administration building	Intentional or unintentional propagation through cuttings	Seed and vegetative	1. Mechanical - Uproot the plants. 2. If the plants are grown ornamentally, its spread must be restricted to the designated areas by uprooting any excessive growths.	1. Shredding of all parts. 2. Sun drying for 15 to 20 days. 3. Spreading in plantation site.	

SN.	Species Name	Observed at locations	Mechanism of spread	Reproduction mechanism	Methods of removal	Methods of disposal	Representative Photo
18	Roundleaf Bindweed (*Evolvulus nummularius*)	Colony lawn	Seeds often dispersed by adhering to the lawn mower equipment.	Seed and vegetative	1. Its spread is usually restricted to lawns and eradication being extremely energy intensive, is not recommended. 2. It is advisable to clean the lawn mower properly when transitioning between different sites.	1. The shavings generated from lawn mowing should be packed in transparent plastic bags and kept in direct sunlight for 15-20 days to kill any possible contamination of seeds before composting or using as mulch.	
19	Water Hyacinth (*Eichhornia crassipes*)	Water bodies surrounding the croplands	The seeds are dispersed naturally by water or water equipment. The plant also spreads by underwater offsets.	Seed and vegetative	1. Mechanical – mass harvesting of the plants must be done in regular intervals to ensure complete eradication.	1. Shredding of all parts. 2. Sun drying for 15 to 20 days. 3. Spreading in plantation site. 4. Spreading the shreds near water bodies should be avoided. 5. Alternatively, the shreds can be burnt off.	
20	Torpedo Grass (*Panicum repens*)	Surrounding scrublands bordering the roads	The seeds are dispersed naturally by air and the plant also form thickets through runners.	Seed and vegetative	1. Mechanical - Uproot the plants before it sets fruit.	1. Sun dry the entire plants for 15 to 20 days to produce hay that can be fed to cattle. 2. Alternatively, dried plants can be shredded and dispersed in plantation site as mulch or burnt off along with rice husk as alternative fuel.	

6.3.5 Snake Management Plan

Concept/ Requirement

Dedicated snake rescuers who comply with all rules and regulations and follow ethical rescues to manage snakes in the site area should be hired. This must be done by consulting the forest department, which might have a list of certified snake rescuers. These rescuers will help maintain a record of snake rescue and activity, which will help estimate the snake population and diversity at the site and help in maintaining the details of the species.

Implementation Measures

Using Proper Snake-Catching Equipment for Snake Rescue:

Snake rescues are crucial to protect both snakes and humans. When snakes are encountered in the plant area, they can cause panic, leading to hasty actions that might harm the snake or pose risks to people. Professional snake rescue ensures that the animal is safely relocated to its natural habitat without endangering anyone. Proper equipment plays a pivotal role in achieving this balance of safety and effectiveness.

Two primary types of snake-catching tools are commonly used:

Snake Hook (Fig 1): A sturdy snake hook is a primary tool for handling snakes. It allows the rescuer to lift and maneuver the snake from a safe distance without causing harm or stress.

Snake Tongs (Fig 2 & 3): There are various types of tongs available on the market for snake rescue. However, tongs with teeth-like ends can cause harm or injury to the snake. Instead, tongs with rubber-coated, flattened tips should be used, as they are specifically designed to grip the snake gently yet securely, ensuring the rescuer can handle the animal without causing harm.

For the safe transportation of snakes, snake bags or tubes should be utilized. If temporary housing is required, escape-proof and ventilated containers are recommended to ensure the snake's safety and containment.

 **Suitable tools for snake handling**	 **Avoid usage of this tool**

While proper equipment is essential, it must be coupled with knowledge of snake behaviour, species identification, and safe handling techniques. Rescuers should undergo professional

Actions to avoid conflicts	Actions in Case of Encounter
• Management of debris from construction activities • Record the type of snakes that are observed within the asset and surrounding region • Provide training to all staff on snake awareness and the actions that has to be taken in case a snake is seen or a staff member bitten • Keep emergency contact numbers of hospitals providing anti-venom, nearby rescuers, or forest department personnel, etc.	• Do not try to catch it yourself, neither try to kill it or take a photo of it as the snake might get agitated and try to attack in defence • Do not go behind the snake and try to take photographs • Leave it alone and give it space to get away • If snake enters any other human occupied area contact a local rescuer or forest department • One person observes the movement of snake • The security persons should be trained to handle snakes using tongs

Actions in Case of Snake Bite
• Call for help • Do not move the part on which snake has bitten to avoid increase of blood flow in other parts of body • Apply a pressure immobilisation bandage • Do not wash or cut the wound • Avoid oral suction of the bite • Do not consume any kind of medicine or apply any ointment without prescription • Take the patient immediately to the hospital • Provide doctor information of any symptoms such as drooping eyelids that manifested on the way to hospital & time of bite

training to understand how to use the tools effectively while minimizing stress for the snake. Misidentification or improper handling can escalate risks, particularly with venomous species.

Information collected for relocated individuals should include:

- Photos of the snake (including headshot) and location detected (including GPS coordinates), notes on habitat type (including rock availability and vegetation), location of the relocated site (including GPS coordinates) and notes on habitat are also necessary.
- A snake rescue and release database should be maintained to monitor cases of multiple rescues of the same snake.
- Awareness and Sensitizing programs of snake bite management, snake ecology, and misconceptions about snakes are essential parts of the management of Snakes.
- Teaching how to act when venomous snakes occur can be very efficient and cause less commotion during rescue.

- Also knowing about the availability of anti-venom in the event of snake bite is necessary.
- Do's and Don'ts Materials on Snake Bite management, Poster on common snakes of the study area etc. would be effective.

6.3.6 Management of Feral Pigeon

Concept/ Requirement

Rock Dove (*Columba livia*), commonly found in urban areas, are highly adaptable and utilize buildings, bridges, and other man-made structures as roosting sites. These birds require minimal nesting material and often exploit architectural features that mimic their natural cliff-side habitats, such as flat or slightly sloped surfaces. However, Rock Doves are considered invasive species, posing risks to local ecosystems and causing nuisance to human environments.

To mitigate their impact and prevent roosting, it is essential to implement targeted management strategies. Understanding how urban structures replicate the birds' natural preferences is crucial for designing effective deterrent measures.

Implementation Measures

Bird Netters: Installing bird netting is an effective way to cover common roosting areas, such as roof-supporting rods, ledges, or beams. The netting creates a physical barrier, restricting access and preventing rock doves from utilizing these spaces for roosting or nesting.

Bird Slides: Bird slides, as illustrated in the figure, are another effective deterrent. These barriers are constructed at a 45-degree angle on ledges, preventing birds from gaining a foothold on metal frameworks or flat surfaces. By eliminating stable landing areas, bird slides also block access to potential nesting spots.

Figure 8. Bird slider for feral pigeon management

Implementing these measures in the plant can help minimize the roosting and nesting of Rock Doves in the plant.

6.3.7 Water Drainage/Storing/Harvesting

Concept/ Requirement

The company operations heavily rely upon groundwater yet no recharge well or rainwater harvesting systems has been installed. To ensure long-term resilience, regular monitoring of ground water levels and reusing treated wastewater for non-critical purposes is recommended.

A pond has been adopted by the company with a recharge capacity of 5292 cubic meter per annum. However, the current state of the pond is poor and requires proper restoration.

Figure 9. Pond adopted by the Company before (2022) and present

Implementation Measures

- The pond can be a great asset for rainwater harvesting and ground water recharge. Although the following measures are recommended to restore the pond from its current state:
- The presence of invasive species as mentioned in **Table 13** should be evaluated in the pond bed and surrounding buffer area. They should be removed and disposed as per the recommendations.
- For desilting, the pond bed can be dug to its original depth using diggers. The removed soil should not be dumped in the near vicinity of the pond. Instead, it should be thinly spread on a nearby agricultural field.
- Make sure to prepare a bed with varying depths (shallow edges and a deeper central part) to support diverse vegetation.
- As the pond will be fed by rainwater, establish bunds and prepare inlet channels to direct rainwater from surrounding lands to the pond. Line the inlet channels with vegetation like Vetiver (*Chrysopogon zizanioides*) to prevent sediment inflow.
- As the pond fills with water, regular monitoring is necessary to prevent the growth of invasive species. It is recommended to avoid introduction of aquatic species in the pond

itself, the native species from the surrounding ponds usually have dispersal adaptations and will naturally colonise the pond eventually.

- It is however recommended to plant native species in the buffer vegetation surrounding the pond. Developing a buffer vegetation of at least 10 meters is recommended to surround the pond.
- Fencing around the pond is not mandatory as it allows grazing and prevents shadowing of the pond by scrub and tree species. However, if the area is prone to excessive grazing by cattle or wild animals, placing the fence closer to the monsoon water level is recommended, in at least some areas of the pond as shown in **Figure 10**. This allows grazing while also protecting the surrounding vegetation cover and preventing unwanted human activities.

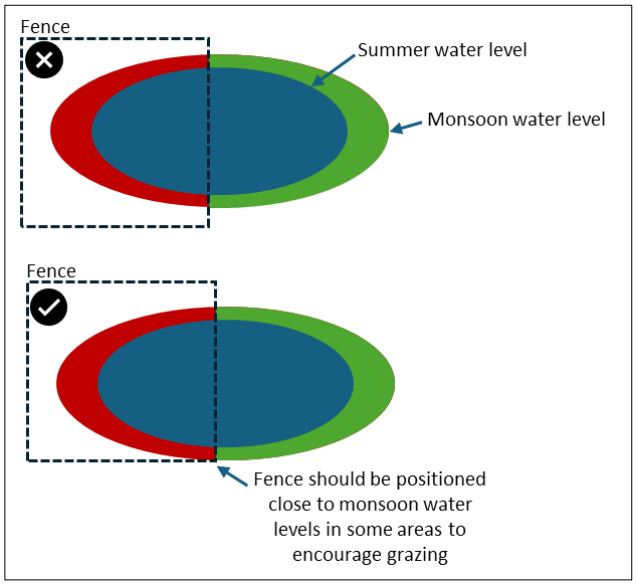

Figure 10. Fencing strategy in areas prone to excessive grazing

- Post restoration, monitoring in regular intervals for the first two years is recommended to check the growth of invasive species. Once the natural vegetation is established, monitoring can be done quarterly.

6.3.8 Developing Miyawaki Forest

Concept/ Requirement

The Miyawaki method aims to create dense, diverse woodlands by using native species to restore ecosystems in urban and degraded areas. This approach involves planting a varied mix of indigenous trees and shrubs at high densities and arranging them into layered canopy structures that resemble natural forests. Extensive soil preparation is carried out, often incorporating mycorrhizal fungi, and no chemical fertilizers or pesticides are utilized, fostering a self-sustaining ecosystem. The method emphasizes rapid growth and natural succession, allowing for a mature canopy to develop in about 20 years. Ultimately, Miyawaki forests boost biodiversity, enhance air and soil quality, provide habitats for wildlife, and support ecosystem services such as water retention and climate regulation.

Implementation Measures

- **Identifying Land and Plot Design:** Create a shortlist of potential sites and perform a site inspection to evaluate the feasibility and scope of the project.
- **Determining Soil Type, and Species:** Examine the geological and soil conditions of the site to identify which species will thrive. Species can be selected as per **Table 11**. Ensure that

nurseries have saplings available and choose a diverse mix of species to foster a balanced ecosystem.

- **Procurement of Materials:** Collect all necessary materials for planting, such as tree guards, stakes, mycorrhizal fungi, mulch, and any required biological enhancements.
- **Preparing the Soil:** Perform soil preparation by digging to a depth of 1 meter, turning and aerating the soil, and reshaping it into a mound based on the site conditions.
- **Planting the Trees:** Plant the saplings at a density of 3 to 5 trees per square meter, ensuring a natural arrangement. Add organic liquid feed if needed.
- **Adding Biological Enhancements and Mulch:** Introduce mycorrhizal fungi during planting and apply mulch to help retain moisture and suppress weeds.
- **Security:** Set up fencing if necessary to protect the newly planted area from animals and human interference.
- **Maintaining the Woodland:** For the first three years, engage in maintenance activities such as watering, litter-picking, mulching, and optional weeding.
- **Monitoring the Woodland:** Optional monitoring can be carried out to evaluate the growth and health of the woodland after three years.

6.3.9 Wildlife Conflict Mitigation

Presence of Wild Animals in the Study Area

Due to limitation of preferred dietary items in the habitat, the animals like Nilgai and Wild Boar are compelled to depend on agricultural crops and plantations. Conflicts with Nilgai and Wild Boar were reported in the adjacent croplands. The Miyawaki plantation established by the company was allegedly destroyed by the same animals. These species are covered under schedule–II of WPA and considered as species of Least Concern importance as per the IUCN.

Human Wildlife Conflict

The general sentiment of locals and towards these species was negative and they reported frequent raiding of local croplands and plantations by them resulting in enormous losses. Studies also suggest that Nilgai damages different crops to about 10-30% while for Wild Boars, the extent of damage increases to 15-40%. In the study area, these animals are currently being deterred by using electrical fencing and other physical barriers.

Habitat Connectivity

Both Wild Boar and Nilgai prefer scrubland and woodland habitats with lesser tree and shrub densities. They avoid dense forest and prefer plains and low hills with shrubs. It is apparent from the observed vegetation and species that the habitat inside the marked boundaries of the company, especially the 10-acre husk storage area shows similarity with the surrounding scrublands. Nilgai mostly feed on grasses but often switches over to browse on fallen leaves, flowers and fruits. While Wild Boars are omnivores with a wide range of diet preference

including roots, bulbs, and seeds. It can also identify cropped areas through smell sensory mechanism. Due to the availability of favourable habitat and food, it is usual for them to enter the perimeter and cause nuisance.

Implementation Measures for Nilgai

- Various methods are recommended to repel Nilgai from the study area without potentially harming them. These methods include physical and biological barriers, non-chemical deterrents, traditional methods and bioacoustics as described below:
- High density plantation of Indian Spurge Tree (*Euphorbia neriifolia*) on the boundaries or paths of access for Nilgais creates a thorny boundary and makes the area inaccessible for the animals including Wild Boar.
- By arranging used sarees of different colours as a fence, animals like Nilgais as well as Wild Boars are made to assume human presence in the area thereby not preferring to enter into such areas.
- Traditional chain link fencing and pulsating power fencing/ solar power fencing with eight strands carrying 12 volts of electricity is effective in restricting the entry of both Nilgai and Wild Boars. The shock intensity will not be able of kill the animal but ward it off, also scaring the nearby individuals due to the alarm calls of the shocked one.
- Spraying a solution of male donkey excreta mixed with cow urine around the boundaries is also known to repel flocks of Nilgai.
- Spraying of repellents like egg solution (20ml/L), or castor oil around the boundaries or paths of access can also effectively restrict the entry of Nilgai.
- Bioacoustics devices produce calls of predators or distress calls of the targeted animal species thereby instilling a sense of fear and avoiding the area. the equipment produces fixed volume of 110 dB and covers 4-5 acres of area with an ambient noise level of 42 dB and up to 19 acres with an ambient noise level of 37 dB.

Implementation Measures for Wild Boar

- Various methods are recommended to repel Wild Boar from the study area without potentially harming them. These methods include physical and biological barriers, non-chemical deterrents, traditional methods and bioacoustics as described below:
- Planting 4-5 rows of high-density safflower crop (*Carthamus tinctorius*) as border is very effective in preventing entry of wild boar. The thorny nature and close plantation (spacing 30 cm between rows and 10 cm between plants) makes the entry for Wild Boars inconvenient. It also generates additional income through the safflower crop itself and very profitable, especially for the farmers.
- Erecting physical barriers around the boundaries using chain linked mesh/ three rows of barbed wires/ GI wire with the first row at 1 ft and the remaining covering up to 3-4 ft height OR fish nylon net (HDP, UV stabilized, 2'' mesh and 1.5mm thickness) of 3-4 ft height can prevent the entry of Wild Boars.

- Traditionally, spraying of local pig dung solution or burning of dried pig dung cakes regularly around the boundary have been proven effective to some extent in repelling Wild Boars on a temporary basis.
- Spreading of human hair collected from local barber shops around the boundary blocks the nostrils causing respiratory irritation and warding off Wild Boars. Distress calls from the affected individual will also scare other wild boars entering the area.
- Bioacoustics devices produce calls of predators or distress calls of the targeted animal species thereby instilling a sense of fear and avoiding the area. the equipment produces fixed volume of 110 dB and covers 4-5 acres of area with an ambient noise level of 42 dB and up to 19 acres with an ambient noise level of 37 dB.

Significance	• Adopting adequate measure for restricting or repelling these species will reduce their conflict with humans. Using traditional and non-destructive methods also promotes their conservation.

6.3.10 Additional Strategies

6.3.10.1 Development of Protected Area

The All India Radio (Prasar Bharti) abandoned radio station land located at latitude 27.998774, and longitude 78.095345, have grown dense vegetation cover over the years comprising of scrub species and mimics the favourable habitat conditions of Wild Animals like Golden Jackal, Nilgai, Wild Boars and other ungulates, Indian Hares, Porcupines, etc. Additionally, the radio towers serve as nesting substrates for Egyptian and Eurasian Griffon Vultures. The land can be potentially developed into a protected area for conservation of the species and generate revenue through availing conservation funds for the species and visitor safaris. Following case studies can be referred to as benchmarks of conservation interventions by private industries:

Case Study: Promoting conservation alongside operations by Syngenta India Ltd.

Syngenta, a world leader in agricultural inputs, owns and operates a facility in Santa Monica Works in Goa, India, as one of the examples of a balanced model between the industrial operation and biodiversity. The facility, established more than four decades ago, spreads across 80,000 m² of land, which covers 12,000 m² of water bodies, and provides a world-class chemical manufacturing and research centre for crop protection products.

Rich biodiversity has been maintained in the site with 87 species of trees, shrubs, and grasses besides more than 70 bird species, reptiles, and mammals such as langurs, wild boars, and porcupines. There is a 12-acre lake in the campus supporting an ecosystem; it is hosting over 40 mugger crocodiles along with fish, turtles, and aquatic vegetation. Special islands have been constructed in the lake to sunbath for the crocodiles.

The lake is also an important wintering ground for migratory birds, with notable species including Oriental Darters, Herons, Bitterns, and various Egrets. These bird populations underline the site's importance as a breeding and feeding habitat.

Syngenta goes beyond biodiversity conservation. Instead, it creates new biodiversity. It shows how the industrial facilities at Santa Monica Works can incorporate their conservation into its operations. That balance is proof of sustainable development and the preservation of local ecosystems while accomplishing the company's agricultural mission.

Case Study: Mangrove conservation through ecological centre established by Godrej & Boyce Mfg. Co. Ltd

Godrej & Boyce Mfg. Co. Ltd., an industrial major in India, examplifies sustainable development and biodiversity conservation. The company acquired 1,500 hectares of land in Vikhroli in 1948 to set up an Industrial Garden Township, which included mangrove-rich khajan lands. With an awareness of the ecological importance of mangroves, the late Mr. Sohrabji P. Godrej and Mr. Naoroji P. Godrej established the Soonabai Pirojsha Godrej Marine Ecology Centre in 1985. The Godrej group reserved 750 hectares of mangroves for conservation. It was pioneering in the sense that there was a lack of awareness and protective legislation for mangroves at the time.

The three-pronged project: research, conservation, and education has visibly benefited the mangroves since its inception 30 years ago. In research, emphasis has been placed on ecological restoration, species inventories, afforestation techniques, and the role of mangroves in controlling pollution and carbon sequestration. An exclusively dedicated mangrove nursery restored 100 acres of degraded land.

The conserved mangroves support diverse fauna, including 20 species of fishes, 15 species of crabs, 7 species of prawns and many molluscs. The terrestrial fauna recorded so far includes 206 species of birds, 33 species of reptiles, 30 species of spiders, over 82 different species of butterflies, and 12 species of mammals, including Jungle Cat and Wild Boars. Migratory birds like flamingos and curlews also consider wetlands vital stopovers on their journey.

The educational initiatives have been raising awareness among more than 5,000 annual visitors that include students, employees, and the public. Nature trails, lectures, and events like World Environment Day and Wildlife Week stress the ecological importance of mangroves.

The Pirojsha Godrej Foundation, holding 24% of Godrej & Boyce, supports environmental initiatives and partners with NGOs such as WWF India to support long-term conservation efforts. This holistic effort demonstrates how private industries can conduct business while preserving the environment, establishing a model for sustainable development.

7 REFERENCES

1. Rajput, S., Kumari, A., Rajput, V. D., Mandzhieva, S. S., Minkina, T., Arora, S., & Kaur, R. (2023) Current scenario, services, concerns, and restoration perspectives of ponds in India. *SAINS TANAH-Journal of Soil Science and Agroclimatology*, *20*(1), 19-31.

2. Sayer, C.D., Biggs, J.,Greaves, H.M., & Williams, P. (2023) Guide to the restoration, creation and management of ponds. *University College London, London, UK*

3. Agrawal, P. K., Verghese, A., Radhakrishna, S., & Subaharan, K. (2016) Human animal conflict in agro-pastoral context: issues & policies. *Indian Council of Agricultural Research, New Delhi, India*.

4. Case Studies of Interventions by Industry. *Indian Wildlife Business Council, Gurgaon, India*

5. Butfoy, L. (2023) Miyawaki Method Hankbook. *Kent County Council, London, UK.*

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